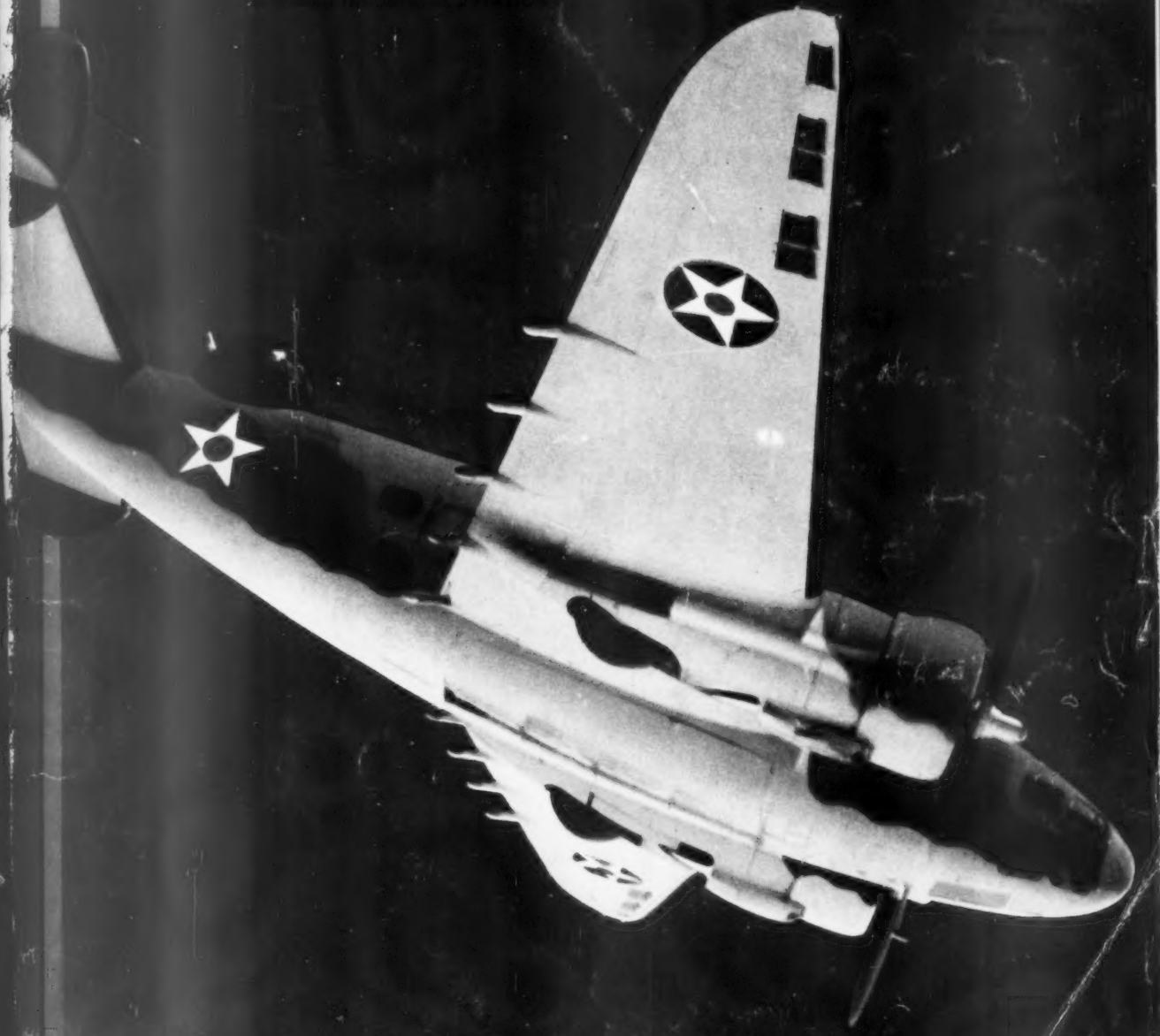
Major Reuben H. Fleet says *"FLY THEM OVER!"*

# FLYING



**TOWED AIR TRANSPORTS** *by* Maj. Lewin B. Barringer

REPORT FROM LONDON ★ ESCAPE FROM JAVA

by Oliver Stewart by Sgt. Pilot D. L. Jones, RNZAF

**FIRST OFFICER CLAYTON BROWN,** of United Air Lines, prescribes a sure cure for his doctor's transportation troubles. Incidentally, Mr. and Mrs. Brown *know their Cessnas.* They eloped in one.

# "Doctor, when this war is over *You'll be Beating the Stork* In Your Own Family Car of the Air"

"No wonder the stork has always had a running start on you doctors," says Clayton Brown. "He flies! But you'll be able to beat him at his own game in your Family Car of the Air.

"You see, ever since I've been a pilot, I've felt sure that some day someone would design a plane so far ahead of anything you see in the air today, that anyone could fly it as easily as you drive your automobile now. And I'm not surprised that Cessna is one outfit that's primed and ready to do it as soon as this war is w

"I've flown Cessnas a lot and I know what re great planes they've always built. Personally, always felt that when I bought a plane of my ow would have to be a Cessna. And now that the Ce Family Car of the Air is ready to be built the peace comes, I know it."

## Put Yourself In This Picture of Tomorrow

Or better still, put your whole family in it. There's lots of room in the Family Car of the Air. All set? Now push the starter button and cruise away as easily as you drive away from the curb in your car. Where to? Well, that's the big surprise. To anywhere your heart desires . . . coast to coast . . . Canada to South America. Six hundred miles is an easy half-a-day ride. And what used to be a once-a-year vacation trip will be just a week-end jaunt in your Family Car of the Air . . . the airplane that *you can buy and fly.*

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FLYING

VOLUME XXXI — *including* INDUSTRIAL AVIATION — NUMBER 5

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*Cover photograph: Lockheed A-29 by Erik Miller*

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THIS GUY IS THE MOST ESSENTIAL UNIT OF PRODUCTION

*He is the Trained Aircraftsman*

## Aviation has JOBS for thousands, but CAREERS only for trained men!

Aviation executives face tremendous organization problems in the production of 185,000 warplanes. They have been forced to accept thousands of single-phase workers from cheap "quickie" courses, but the vital supervisory positions that bridge the gap between raw material and fighting ships can only be filled by men thoroughly trained to solve any problem assigned to them. The career man with long-range training is the ESSENTIAL unit of production . . . and ONLY he will continue to be essential through the readjustments that must follow when America's war production shifts back to peace-time schedules.

The executives who have made aviation THEIR career know that the value of each man is governed by two factors: his intelligent sincerity in selecting aviation as his life work, and THE ABILITY AND EXPERIENCE OF THOSE WHO TRAIN HIM FOR THAT CAREER. They know that Curtiss-Wright Technical Institute graduates are — and for many years have been — thoroughly qualified to fill the industry's exacting requirements.

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It is imperative that before you invest in a course of career training you determine what the returns will be on your investment . . . for your choice of a school in which to take your training will determine how much money you will make all the rest of your life.

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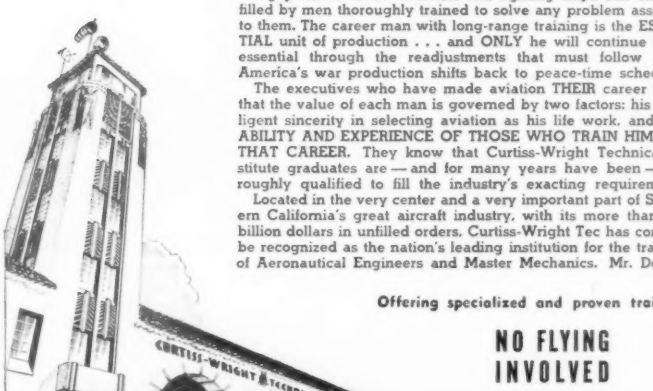


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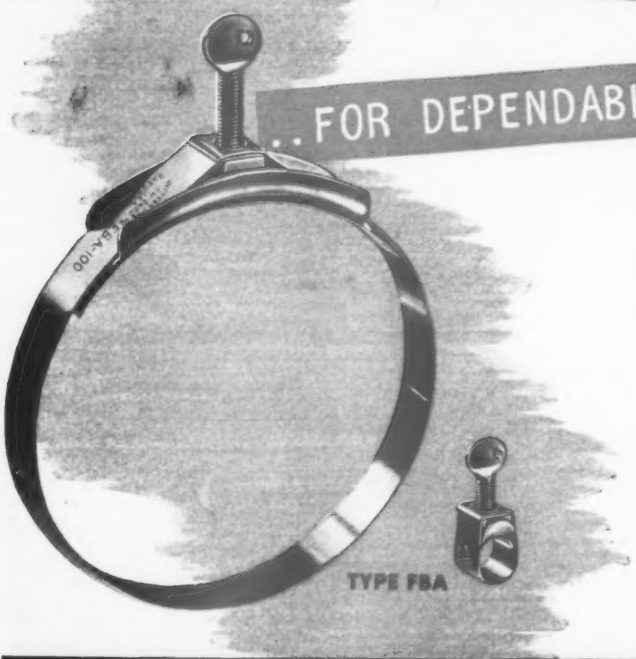

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Every day our ferry crews are placing their confidence in Kollsman Precision Instruments, for thousands of those planes are Kollsman-equipped to a high degree.

We're proud of the part Kollsman instruments play helping them cut through "Atlantic soup."

R.S.V.P.
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Request
THE PRESENCE OF THE REMAINDER OF THE JAPANESE FLEET IN THE PACIFIC

But we cannot afford to be overconfident because if we are, we are fooling only ourselves. Our bombers are harrying and smashing the enemy from the Solomons to Rouen, but in the whole picture of the War, these are skirmishes. Actually, "We have not yet begun to fight," and we can't until each of us is actively engaged in the War Effort.

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UNITED STATES STATE DEPARTMENT — ROYAL AIR FORCE

AS a leading editor put it recently, American military aircraft are fighting two battles: one against the enemy and the other against critics here at home. The former is going fine, the latter is being lost. If for no other reason than national morale, some means should be found to shut up those "experts" who in reality haven't any but the most elementary knowledge of aviation, but who have no qualms about condemning nearly every type of aircraft in use by our armed forces today.

You have heard it over and over again: The P-40 is the worst death-trap ever flown; the *Flying Fortress* is just a clumsy, overgrown airliner; the Allison engine is the worst piece of machinery ever invented. And so on. But then, for some apparently unexplainable reason, the P-40 whips three times its weight in Japs, twice its weight in Germans. The big Boeings fight the war in the South Pacific almost single-handed and do an amazing job against the Germans—with many of the Nazis' latest fighters shot down as a sideline. The Allison engine is largely responsible for the fine job being done by the P-40's, the Bell *Airacobras* and Lockheed P-38's in Australia, Libya, Alaska, Greenland and Iceland—everywhere, and in the most widely varied climatic conditions.

There's only one conclusive answer to all the poppycock being dished out to the newspapers: look at the box score. If our air forces are getting their present results by riding on broom handles, then for the sake of all civilization let's go into all-out production on broom handles. If our equipment is as awful as some people say, then we'll surely be able to whip the whole world with one-third of our present air force once we get some "good" aircraft. Meanwhile, next time you read statements by someone branding our aircraft as so much junk, consider long and carefully that man's qualifications before you believe a word of it. It's asking a lot, but it's the only way the American people will eventually learn the truth.

There are those who lately have said that American successes have been due almost entirely to our superior pilots, not aircraft. Which makes just about as much sense as if we said that Wilbur Shaw could win the Indianapolis auto races in a wheel chair.

* * *

Though we're getting used to it, it still is an unbelievable sight to see the volume of production of our aircraft industry today. We recently toured four factories in the east—four of the largest in the world. At three of the four, we saw enough completed airplanes standing outside the factories to outfit a whole air force the size of ours just a few years ago. This despite the fact that production is being seriously hampered by those famed jinxes, bottlenecks. An engineer at one plant, for instance, told us bluntly that if we could supply just the engines, he could *double* that company's production of a certain widely-used aircraft.

Yet, despite the fact that what we saw of the industry on our recent trip was only running about 60 per cent of capacity, we were amazed at the numbers of completed fighters, bombers and cargo planes rolling off the lines. If only the general public were permitted to see the American aviation industry and what it is doing—and still can do—there would not be the confusion set up by the many sure-cure schemes that have been so widely publicized.

* * *

MANY young men all but had their hearts broken during the past several years after being rejected as Army or Navy pilot material because of some hair-splitting regulation. Most of these men apparently don't know it, but they stand an excellent chance of making the grade this time if they care to try it.

(*Continued on page* 141)

LET'S GO! U.S.A. KEEP 'EM FLYING!

For the time being, we must part . . . you go on ahead . . . as a symbol of Waco's strength, character and performance you're "tops." We know you will continue to uphold the famous Waco tradition. You are the last of your particular breed, for a while, but any time you or your boss are in trouble, let us know. We'll still have time to doctor your bruised legs and bandage your cuts and wounds. You are back of the lines but you still have one of the toughest scraps to finish.

You'll be proud of the new family we are rearing here at Waco. Strangers to you because you have never seen them. But they've heard of you and don't think for a minute they aren't proud of you. You'll be proud of them, too. They're a little different because we are raising them for a different purpose, but don't be afraid they'll let you down or jeopardize your reputation because they are "just what the doctor ordered." And believe it or not, they will transport 15 fully equipped fighting men. All this, without an engine.

You both have a big job to do in assuring America's freedom . . . freedom of the air.

WACO AIRPLANES

THE WACO AIRCRAFT COMPANY • TROY, OHIO • U. S. A.

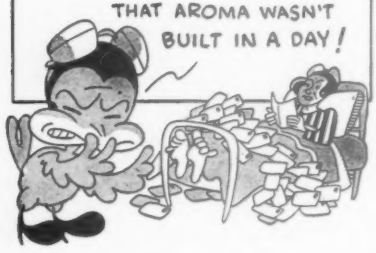
# The Birdmen's Perch

Oh, see the little Major,
He's out upon a twig;
He promised to name Oily but
The job grew much too big.

The letters came in bunches—
The Major read and read,
He read while he was eating,
He read while in his bed.

He read under the shower;
He read the postal blitz
In restaurants and buses,
In Washington and Pitts.

The Major still is reading,
But takes time off to vow
That Oily will be christened
Just four weeks from now.




*Major Al Williams*

alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

## MOIST, HAVE BEEN SOME THINGS THEY WET

Remember a while back, when scientists discovered a way to make water *wetter?* Well, Gulf's scientists discovered a way to make oil *oilier* when they invented the Alchlor Process. For no matter how good the crudes, all oils contain molecules that form carbon and sludge, in addition to the molecules that actually lubricate.

Gulf's exclusive Alchlor Process gets *more* of these carbon and sludge makers out of Gulfpride than ordinary refining techniques would, leaving Gulfpride an *oilier* oil.

## BRAINTWISTER (The Good Ferry)

The planes at Newfoundland Airport were joined by 1 flight of 7 new planes each day for a week. After each new flight arrived, half the planes on the field took off for England. At week's end, there were 8 planes left on the field.

*How many were there in the beginning?*

## WHOPPER

Dear Major,

Recently one of the instructors went fishing, carrying as always a small bottle of Gulf Aviation Gasoline "for emergencies." After fishing a while, he ran out of bait and headed home to the Station. Half a mile up the path he saw a big snake with a frog in its mouth. He walloped the snake with a stick, took the frog, and started back to the river for more fishing.

But the death struggles of the snake were too much for his soft heart. Having no water, he gave the snake a shot of

G.A.G. and returned to the river, feeling a proper Christian.

He fished a bit before he felt a tug on his trousers. He looked down to see the same snake with another frog.

**W. Bruce Haughton, Senior Instructor, Airplane Phase, Navy Air Service School, Florida**

**Gulf Oil Corporation and Gulf Refining Company... makers of**

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...PISTON IN STANDARD PISTON ENGINE HAS RESULTED IN REPEATED FAILURE OF THE NEW PISTON DUE TO OVERLOADING
...DETONATION OCCURRING WITH REGULAR 73 OCTANE FUEL. BUT YOU'LL PROBABLY NEVER HAVE TO REPLACE A PISTON...
... IF YOU USE THAT GOOD GULF AVIATION GASOLINE
G.A.G.

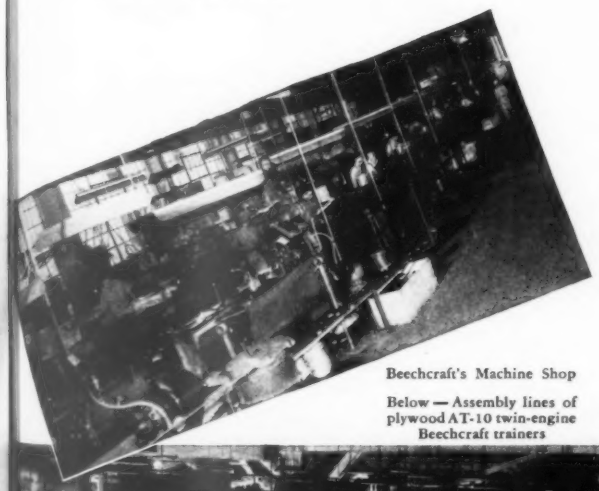
# Subcontracting

*It obviously would be impossible for the little machine shop shown here to feed the necessary parts to the many Beechcraft assembly lines, some of which are not shown here.*

Above — Assembly lines of all-metal AT-11 twin-engine Beechcraft bomber trainers

*More than 2 years ago* **Beechcraft** *initiated an extensive subcontracting program which absorbed the impact of priorities on the normal business of scores of machine shops. Loyal, hardworking subcontractors now are devoting to Beechcraft's business an aggregate floor area that exceeds the total productive area of the Beechcraft factory. This has made possible the release of new machine tools to others and has prevented the dislocation by war conditions of many well-managed enterprises.*

*Beechcraft's experience is that properly directed subcontracting is a flexible and efficient way to increase output.*



Beechcraft's Machine Shop

Below — Assembly lines of plywood AT-10 twin-engine Beechcraft trainers

Beech Aircraft CORPORATION

BEECHCRAFTS ARE DOING THEIR PART

WICHITA, KANSAS, U.S.A.

With today's gas, oil and tire shortages, Harley-Davidson Motorcycles assure faster, more convenient miles-per-dollar than any other kind of motorized transportation. Dependable Harley-Davidsons long have been famous for *unmatched economy*. That's why their owners are extra fortunate these days. Whether using their sturdy motorcycles to ride to and from work — or in volunteer civilian defense — they're always sure of top performance — just like the courageous riders of Harley-Davidsons with America's armed forces. While there are no new Harley-Davidson Motorcycles available now for civilian use, your dealer may have some good values in reconditioned models. See him today.

ON AMERICA'S FRONT LINE OF ACTION

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**MOTORCYCLES**

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# Letters

## RAF Issue

Sirs:

BALFOUR, UNDER SECRETARY OF STATE FOR AIR, SENDS HIS CONGRATULATIONS TO YOU ON RAF ISSUE OF FLYING WHICH HE CONSIDERS SPLENDID PRODUCTION. PLEASE ACCEPT MINE AT THE SAME TIME, ON WHAT IS A FIRST CLASS JOB, AND WHICH WILL LEAD, I FEEL SURE, TO GREATER UNDERSTANDING BETWEEN OUR TWO COUNTRIES AND THEIR FLYING SERVICES.

H. N. THORNTON, Air Commodore
Air Attaché
British Embassy
Washington, D. C.

Sirs:

Sir Arthur Street, Permanent Under Secretary for Air, asks me to convey to all your organization concerned with the production of the special Royal Air Force issue of FLYING his heartiest congratulations on the magnificent achievement. I would also like to add the congratulations of the RAF Delegation in Washington and to thank you for your co-operation throughout all stages of the work.

J. P. GRAHAM
Squadron Leader, Royal Air Force Delegation
(British Air Commission)
Washington, D. C.

Sirs:

. . . The RAF issue seems to have made a hit, both in the critical atmosphere of the Air Ministry, and over here. I was told in the War Department yesterday that the air services here are very greatly impressed. . . .

BEN TRAVERS
Squadron Leader Royal Air Force Delegation
(British Air Commission)
Washington, D. C.

Sirs:

. . . It is a splendid issue and typical of the valuable service you are rendering to the cause of aviation.

ALFRED HAND
Management Planning Officer
Department of Commerce
Civil Aeronautics Administration
Washington, D. C.

Sirs:

. . . I thought that your other special issues would be hard to beat, but you seem to have done it with this one. It is a graphic presentation of the air power of our greatest and strongest ally. With the combination of the British and American air forces into one smashing, driving, hard-hitting power of alert, resourceful men and powerful well equipped machines, the reality of a second front should hold no fear for the military leaders of either nation. The excellent showing of both forces engaging the enemy in Europe, Africa and Asia should show all the peoples of the world that our hard fighting democracies have the ability to return more than the enemy can give and *give more than the enemy can take.*

Being a defense worker myself I realize that it is necessary for us at home to keep the wheels of industry turning at full speed in the all-out effort to keep the supply as close to the demand by our armed forces as possible. Our greatest possibility and only hope of whipping the Axis is to let our nation's free labor outsupply their slave labor in all forms of military production. . . .

WARREN HECK
St. Louis, Mo.

Sirs:

. . . It certainly reflects the vast amount of effort put into its preparation, and I am proud to include it on my bookshelves.

CAPT. W. W. WEBER, USN
Naval Aircraft Factory
Navy Yard
Philadelphia, Pa.

Sirs:

. . . In going through this special issue, I can see that again FLYING has done an excellent job in presenting the complete facts regarding the Royal Air Force. . . .

GORDON L. FREEDMAN, President
Freedman-Burnham Engineering Corporation
Cincinnati, O.

Sirs:

Just a line to tell you how much I enjoyed FLYING for September. It's always better and better, but this current number is superlatively good—in fact, the best aviation magazine anywhere, anytime. . . .

LIEUT. COL. GORDON REEL, A. C.
New York, N. Y.

Sirs:

I've just bought a copy of the special Royal Air Force number of FLYING. It's really a swell number and is as good as the Army and Navy issues of last year.

S. HERD, 1169212, A. C. I.
RAF Picton
Ontario, Can.

Sirs:

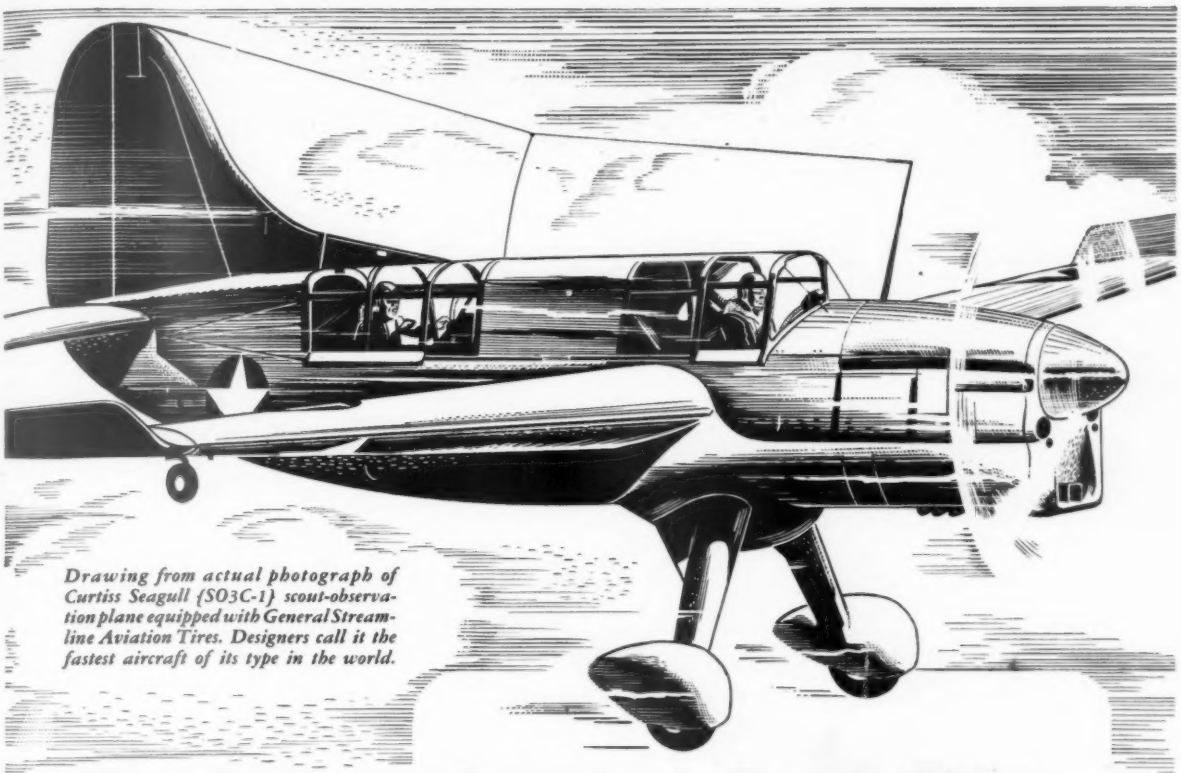
We did so enjoy this September issue of FLYING. Though our son is one of the members of the Eagle Squadron, he can tell us little of what he does as far as war goes, so your very fine number gave us information we were so happy to know. . . .

MR. AND MRS. J. E. PECK
Berkeley, Calif.

Sirs:

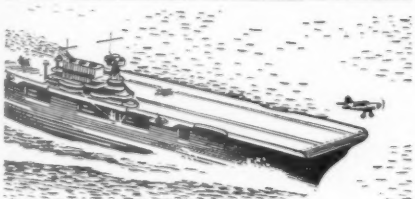
. . . This is certainly a beautiful piece of work, upon which your company is to be congratulated. I am enjoying it to the

(*Continued on page* 130)



*Drawing from actual photograph of Curtiss Seagull (SO3C-1) scout-observation plane equipped with General Streamline Aviation Tires. Designers call it the fastest aircraft of its type in the world.*

# "The Eyes" of America's Battle Fleet have to sit down on a "dime"... fast



Scout-observation planes for the U. S. Navy have to cover the area in a hurry . . . and the faster they are the greater their scouting range.

While equipped with floats when based on cruiser or battleship . . . it's *the tires* that take the beating when these super-fast Navy "eyes" operate from and return to a carrier or naval land station.

America now has the world's fastest ship-based planes—and General Tires have proved that they have the built-in strength and quality equal to the high speed landings and split-second stops.

With one of the longest records of practical experience in building aviation tires, General today is helping to bring *safety* to every branch of aviation . . . whether CAP ship, trainer, fighter or heaviest bomber. For your safety, too . . . depend on General.

*See your Fixed Base Operator or Write,*

**THE GENERAL TIRE & RUBBER CO.**
*Aviation Division, Akron, Ohio*

The GENERAL AIRPLANE TIRE

—KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY

# WE'RE SHIPPING SILK BACK TO JAPAN!

☆ To bring Peace to this mad world, we are sending our Bombers over the "Land of the Rising Sun", manned by American boys protected by 'chutes made of silk.

Our entire production of parachutes is being devoted to the service of our Armed Forces. Before the war Switlik 'chutes were used by the majority of pilots in the United States, and we are preparing now to accommodate the requirements of a tremendously expanded aviation industry after the war.

How?

By constantly redesigning and improving our 'chutes; by incorporating more safeguards, finding better materials, developing better workmanship and lowering the cost. Our specifications are now, and always have been, more rigid and exacting than even those laid down by the watchful Civil Aeronautics Authority.

So, when the last battle has been won, you will find us prepared to meet the needs of America's new army of peacetime pilots.

Faithfully,

Stanley Switlik
President

**SWITLIK PARACHUTE COMPANY**

AMERICA'S LARGEST MAKERS OF PARACHUTES
TRENTON, NEW JERSEY

**FIVE REEL SOUND FILM 16MM**—"Parachutes for Safety" may be had for a one-day showing by flying schools and colleges upon request. This unusual film describes the manufacture, packing, service, maintenance and use of parachutes. Write on letterhead to Switlik Parachute Company, Trenton, N. J.

**LIGHT** . . . to deliver maximum horsepower and maximum fight-power per pound.

**STRONG** . . . for safety and for long fighting service.

**SIMPLIFIED** . . . unit-construction for dependability, plus automatic control for improved performance.

## . . . THROUGH THE NOSE of a new, brilliantly engineered propeller

On a dozen fronts, many of the Army's fastest fighter planes are charging into action behind a propeller that packs a gun in its nose—a propeller called AEROPROP that brings to both pilot and plane new speed, power and safety.

Built into the Aeroprop are engineering triumphs undreamed of scarcely a year ago. Hollow, rib-reinforced steel blades make the Aeroprop LIGHT, thus delivering maximum horsepower per pound. At the same time, the Aeroprop blade is amazingly STRONG because it is made of rugged steel, five times stronger and many times more plentiful than aluminum. SIMPLIFIED unit-construction and fewer parts provide completely automatic pitch control under all flight conditions with the power for pitch changes self-contained in the compact propeller assembly itself.

What does this mean to the United Nations and to the pilots who daily fling their planes at enemy targets? It means that their striking strength, their safety, and their chances of success are all improved by a propeller engineered to make the most of the engine's power and the plane's design.

* * *

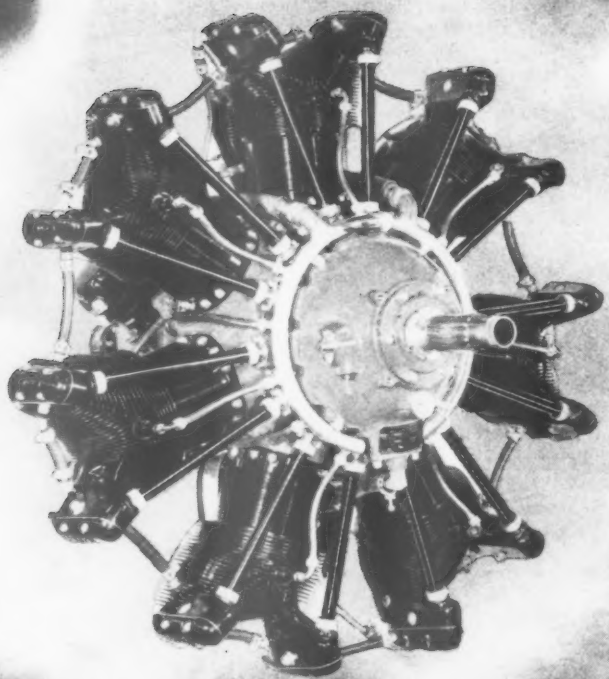
*Merely months ago all this was just a designer's dream. Today, it is a hard, fighting reality, thanks to the teamwork between propeller engineers, production soldiers and technicians of the United States Government. The Aeroprop's brief but brilliant history from plans to planes is proof of what happens when a democracy rolls up its sleeves.*

AERO PROP

AEROPRODUCTS DIVISION

GM ARMS FOR VICTORY

GENERAL MOTORS CORPORATION



# JACOBS
## Engines

JACOBS AIRCRAFT ENGINE CO.
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No

PHOTO OF C-54 TRANSPORT COURTESY DOUGLAS AIRCRAFT CO., INC.

# LEADING A DUAL LIFE

WHAT landing gear to put on such a big ship and where to put it were the problems handed to "U. S." engineers.

One of them suggested dual wheels and tires. Experiments with airplane duals showed greatly increased flotation. They spread the load over more surface, increased the usefulness of this plane by multiplying the number of places where it might land and take off.

Other advantages developed, too. With *dual tires* retracting space was better designed and more compact. Tires could be smaller, lots easier to install and to service.

So airplane tires now lead a dual life. Performance is increased; everyone is happy.

Could you make use of practical field assistance on tire and undercarriage problems? There is a whole staff of "U. S." field engineers ready and eager to jump at problems like that.

ROYAL AIRPLANE TIRES

## ONLY "U. S." HAS THESE EXTRAS

1 **TEMPERED RUBBER TREAD**—A tougher, scuff- and heat-resistant tread compound for airplane tires.

2 **SAFETY BONDED RAYON CORD** — A lighter, more resilient, airplane tire material with tremendous impact resistance and stamina at high temperatures.

3 **FIELD AIRPLANE TIRE SERVICE**—A force of "U. S." field engineers in every part of the country is promptly available for engineering and technical help on tire and undercarriage problems.

4 **"U. S." ICE GRIP TREAD**—A tread of revolutionary design and performance for snow- and ice-covered landing surfaces.

5 **STATIC GROUND CONSTRUCTION** — Conductive rubber construction grounds static electrical charges upon contact with the ground. This safety feature is available in every U. S. Royal Airplane Tire.

**RAYON IN EVERY U. S. TIRE — A U. S. TIRE FOR EVERY PLANE**

# UNITED STATES RUBBER COMPANY

AIRPLANE TIRE DEPARTMENT • 6600 E. JEFFERSON AVE. • DETROIT, MICHIGAN

# FLY THEM

by

## Maj. REUBEN H. FLEET

*Major Fleet, founder of Consolidated Aircraft Corporation and builder of the largest integrated manufacturing establishment now operating in America, is a former U. S. Army Air Service officer. During the last two decades he has been a leader in the development of the airplane to its high state of efficiency. For his many accomplishments in aviation he recently was given the 1942 Award of Merit by the American Academy of Public Affairs. Formerly president of Consolidated, he recently retired, now is company adviser. He lives in San Diego.*

*This blitz war demands fast movement of airborne armies. Major Fleet believes that the aircraft industry can provide the carriers.*

AS adviser to Consolidated Aircraft Corporation, I wish it clearly understood that in the remarks here I voice my own opinions, which do not necessarily reflect the policy of the company.

The other day at a speech in Los Angeles before the American Academy of Public Affairs and the Los Angeles Breakfast Club, I suggested 400-passenger troop-transport airplanes to carry our armies abroad, keeping in mind that defense will not win this war; that to win we must attack, that to attack we must rush armies to the front, to points of vantage where they can strike at the very vitals of our enemies.

The wholesale dispatch abroad of our soldiers indicates we are taking the offensive on several fronts. Aggression in warfare demands that the attacking force be equipped to move great bodies of soldiers rapidly and effectively. This is a blitz war, requiring air-borne troops at four miles per minute, instead of ocean convoys at six per cent of this speed.

To some extent in this regard we have streamlined our armed forces. For example, our infantry has been motorized and our artillery is moved by trucks rather than by horses. But German submarines have already sunk more than 400 of our surface ships. We need air-borne troops—whole armies moved by air. During the last war our Navy moved millions of soldiers to Europe without loss of life. The Navy should now take to the air with that transport task.

Many people ask me, "Will it be necessary to await the construction of 400-passenger airplanes before such air-transport can get under way?"

To this I say, "No." While we are making 400-passenger planes, we should continue our present great airplane construction program. The new troop-air-carrier-building-program should be supplemental to it. The cheapest and quickest troop-carrying aircraft to get are cargo and passenger-type bombers (such as *Liberators*, now in mass production). One thousand *Liberators*, or aircraft of similar capacity, could carry 350,000 men overseas in a month. Special *Liberator* fuselages could almost treble that.

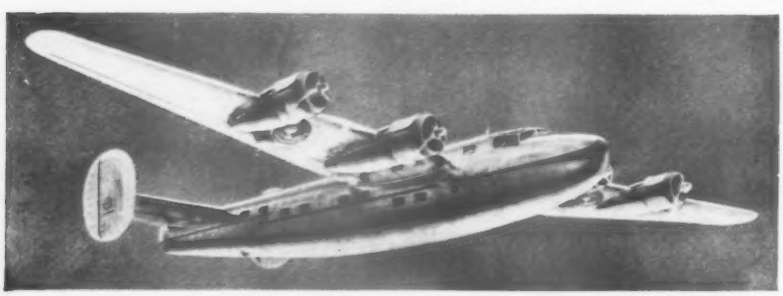
Our aviation industry could have such a fleet well within a year. Simultaneous production of the gigantic troop-air-transports would be started immediately. Our armies would begin flying overseas in aircraft of the *Liberator* type. And such troop air-movement in four-motored aircraft would be safer for our soldiers than ship convoys. Skylanes are relatively safe; no hidden shark can wait in the air with stilled engines to attack its prey. Troop-carrying aircraft would not even have to be armed. As they enter the danger zone they would be escorted by fighting planes to a safe landing. This plan solves one of our greatest problems; soldiers could anticipate fast and comparatively safe air trips overseas. For many it would be a first venture in aircraft.

At the present I shall not attempt to describe in detail such mammoth aircraft, nor give specifications which might constitute military secrets, but I can indicate what performance might be expected of such gigantic troop-carrying aircraft.

These airplanes would be about five times larger in weight when loaded than those in war use today. Without offending Government censorship, I can say that the same minds that conceived and produced the *Liberator* (already widely used by our Air Forces and the United Nations), and the PBY flying boats long-range air-eyes of our fleets), have planned this greater airplane to the point where our industry could begin its production. Such mammoth aircraft could cross the United States non-stop in from 10 to 12 hours, or span the Atlantic to a theater of war in equal time with crew and 400 soldiers. As bombers, they could make non-stop trips to Europe and return. As sky freighters they could take heavy loads of supplies and armament to overseas troops, and carry goods to our Allies where sealane traffic is too hazardous.

The day has arrived when Washington must face this fact seriously: Axis submarines constitute the gravest peril our shipping has ever known. Our lines of supply to our allies are threatened on the

Commercial version of Consolidated's B-24 "Liberator," sketched over a year ago. One thousand of these craft could transport 350,000 troops overseas in 30 days.



# OVER!

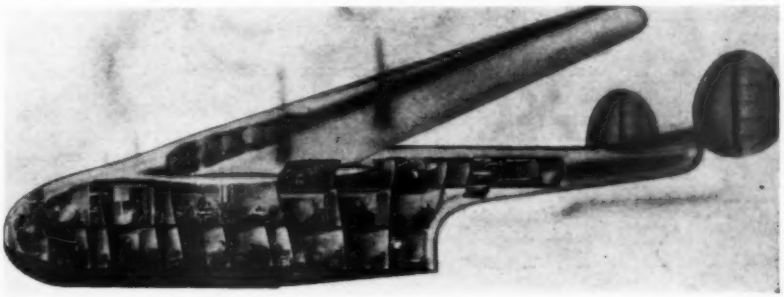
ocean. We must take to the air in unprecedented fashion, if we are to give proper protection to the lives of our soldiers in transporting them to foreign posts of duty. Our boys are entitled to the best protection we can give them, wherefore we should transport our armies by airplanes. The soldier of the immediate future — and the man under arms and awaiting orders to a foreign shore—could by this method of transportation anticipate a fast trip by air to join his comrades in Europe, Australia or elsewhere.

Whether or not each soldier would be equipped with a parachute would depend upon regulations adopted by our Army authorities. Normally a parachute would be superfluous for the ocean trip, for the aircraft would be landed to discharge its soldiers. But it might be that exigencies would require rapid air-delivery of troops at a scene of action without possibility of landing. Under these circumstances a soldier might enter a troop-carrying aircraft, fly across land or even an ocean, and parachute down to a battlefield abroad. The airplane that conveyed him there might have to proceed from the area of discharge to a suitable site for refueling for its return trip.

(*Continued on page* 144)

Consolidated B-24's of the Army Air Forces could quickly be converted into troop transports without destroying their primary function as fast, long-range bombers.

Four years ago Consolidated Aircraft had drawn designs for huge flying boats, such as this version of a three-deck, 100-passenger ocean liner. Note use of wing space.



The "Big Eight*" of California's aircraft industry have checked self-interest for the duration.

# SPEED-UP SPECIALISTS

by PAUL PIERCE

*The keen competition of peaceful days has been forgotten as the Aircraft War Production Council members pool all resources to boost output.*

WHEN Mary Smith needs a teaspoonful of baking powder to finish up a batch of biscuits she runs next door and gets it from Sally Jones. Likewise, when Joe Vultee needs a thousand pounds of rivets to finish up his dive bombers he calls up Pete Lockheed across town and gets his rivets. That's why warplanes are popping out of Southern California aircraft factories like hot biscuits.

Under the ponderous title of The Aircraft War Production Council, Incorporated, eight of the world's greatest aircraft plants have gotten together and are working as one to turn out more airpower per hour. Consolidated, Douglas, Lockheed, Northrop, North American, Ryan, Vega and Vultee have pooled their machines, men, materiel, trade secrets and enthusiasm for the single purpose of smashing bottlenecks.

These eight factories have spent most of their existence in keen competition for manufacturing supremacy, but now they're all doing the same job, helping to lick the Axis; and they're all building the same type of airplane, magnificent fighting craft for the allied nations. To this end they have abolished competition, personnel raiding and trade secrets of any kind.

For example, Northrop was ready to go with a new fighting plane except for the landing gear design. It looked as though the project would have to wait for the necessary engineering. North American heard about it through the Council and volunteered the gear which had been designed for the B-25 bomber. With only minor changes it worked perfectly and the Northrop ship was ready months ahead of schedule. Vultee handed over to North American engineering data which had cost $250,000 to assemble. Vega ran into trouble in producing the Boeing B-17F *Flying Fortress* and borrowed 30 engineers from Vultee. As a result Vega is now six months ahead on its *Flying Fortress* schedule and the first Boeing built in the Vega plant was in the air long before our Government expected such results.

The plan works so smoothly and with so little red tape that few men in the industry realize how much it has speeded up our war effort. The Council report for a typical month, however, shows 1,860 potential bottlenecks broken in a span of 30 days. There were 1,557 exchanges of material made either on a loan or no-profit sale basis. A total of 132 engineering reports and 171 library references to technical reports were among the transactions of the month. Some of these exchanges were very minor, but many of them solved potential production delays which might have held up vitally needed aircraft for weeks or

* Left to right: Robert Gross, Lockheed; Richard Millar (since retired); Harry Woodhead, Consolidated-Vultee; J. H. Kindelberger, North American; LaMott T. Cohu, Northrop; Donald Douglas, Douglas; T. Claude Ryan, Ryan; Courtlandt Gross, Vega.

Magnetic riveting device invented at Lockheed plant made possible a faster construction job on the P-38 "Lightning."

Installing hydraulic landing gear at Douglas plant. Members of the Council share talents of engineering staffs.

months. Thus the plan of co-operation gives to America free the one thing it can't buy with its tremendous war chest, time!

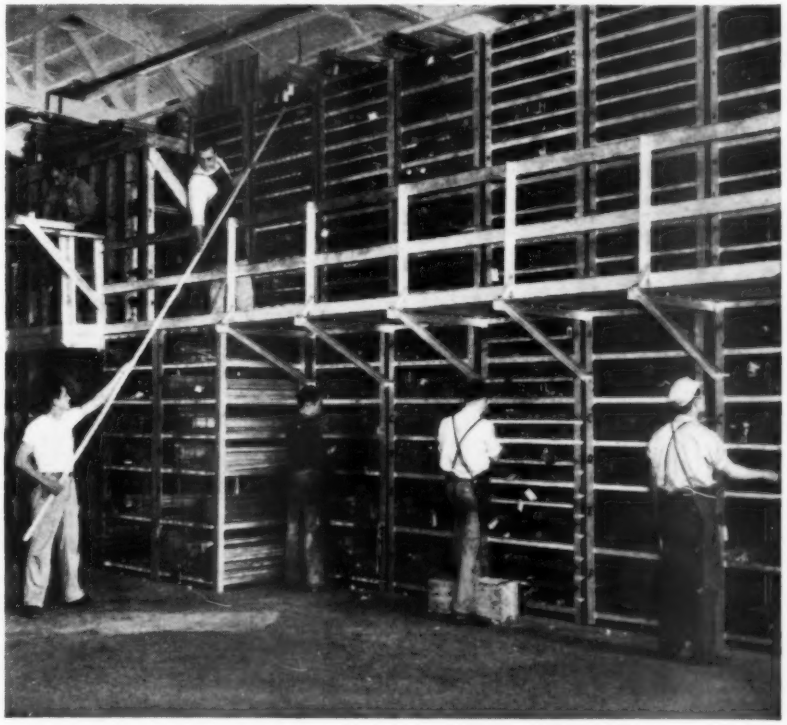
The Aircraft War Production Council sprang from informal luncheon meetings of the presidents of the eight factories concerned. These men, all of them young, aggressive, pioneer aircraft builders, realized soon after America entered the war that the President had given them a big job when he asked for 60,000 warplanes this year. They knew they would have to forget competition, work together and build planes in a hurry. Already they were exchanging material and services out of necessity, and the decision was made to continue the informal meetings and expand industry co-operation, but on a controlled basis. In exactly 11 days the Council was formed and production started to jump.

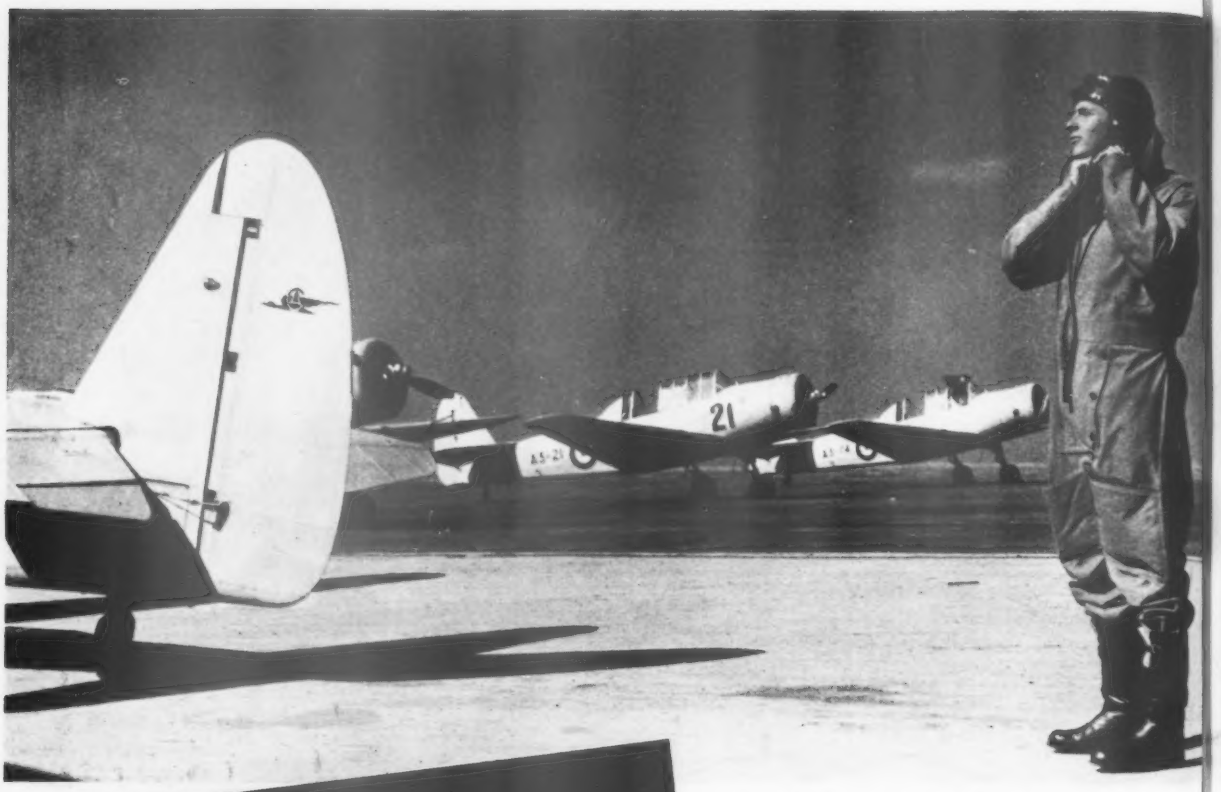
Not only have these eight plants been able to live up to the nation's demands, but (with Boeing in Seattle) they have turned out more than 60 per cent of the planes we have today. In addition to licking their own production problems these manufacturers have contributed their plans, processes and technical knowledge to the training of the automobile and other industries which now are stepping into warplane production. Soon the newcomers can add their products to the rapidly increasing airpower of our side.

The eight plants forming the Council

(*Continued on page* 116)

A plant's stockroom contains many thousands of small items. When a shortage of anything threatens the production line, other plants lend needed parts at once.





Australian-built Wackett trainers, forerunners of an aircraft industry that now rates absolute A-1 priority.

# AUSTRALIA BUILDS AN AIR FORCE

by KEITH PALMER

*The Aussies have created their own aircraft industry "down under." It may well prove a decisive factor in the outcome of war in the Pacific.*

THE war of design and production between the aircraft makers of the United States and Britain and the technicians of Germany, Japan and Italy has its echoes in Australia.

Australia's aircraft industry is only four years old. Originally it was geared to produce nothing more than primary and advanced trainers. During the first two years of war Australia—if it appeared in the world aviation picture at all—appeared as a manpower farm for aircrews (20,000 aircrewmen scheduled annually) who would fly the combat ships of Britain. The role of the aircraft industry was to turn out enough trainers to relieve the technically advanced plants of Britain from the job of producing the workhorses of the air schools. That Australia was able to do this at all—that it could announce after mid-1941 that 1,000 Australian-built warplanes were in the air—was a matter for Australian self-congratulation.

As the Pacific crisis deepened, Australia began producing its first combat type airplane—the Bristol *Beaufort* torpedo bomber. Two considerations dictated the type. It seemed the logical type for offensive action against shipping (it had just rolled up an impressive victory at Taranto) and Australia had 11,300 miles of coast. The other matter was that its twin row American power plant was similar to that of the *Wirraway* (single row).

In November, 1941, the Australian aircraft industry seemed to have everything under control. Pearl Harbor changed all that. Australia suddenly needed firstline aircraft and plenty of them. More, the United States would have first call on the American aircraft part and machine-tool industries, both of which had contributed to the establishment of the Australian industry. It was not the first time Australian production problems had been increased by world events. The collapse of France and the airblitz against Britain robbed Australia of aircraft and plant ordered in 1939.

But this was nothing to the drastic revision dictated by Japanese entry into the war. Australia needed fighter planes and first line bombers. Immediately aircraft production was given an absolute priority of men, plant and finance over everything else in Australian war production. The aircraft production chief, Essington Lewis, became the most powerful

Largest warplane built in Australia is the Bristol "Beaufort" torpedo-bomber. It is powered with U. S. engines.

official in Australia. The painfully created Australian machine tool industry began turning out the specialized tools necessary to make—for the first time—fighter and fighter-bomber types.

Government statements in April seemed to indicate that production of these new first-line ships would not be delayed. In any case, whether or not they arrive soon enough to alter the immediate picture of General Brett's air strategy in the Southwest Pacific, production in any quantity —for a country that has yet to make its first automobile—will have been a minor production miracle. At this stage it might be appropriate to give some background to Australian airplane building.

Key technical man in Australian plane-making for years had been Lawrence James Wackett, World War I flyer, now the 45-year-old head of Commonwealth Aircraft Corporation. He made his first airplane in 1923, called it the Wackett *Warbler*, and eventually coaxed it up to 5,000 feet. It had a two-cylinder motor producing about 22 h.p. at its best. But it flew and its engine, like the rest of it, was Australian-made.

Next Wackett job was the *Widgeon I*, an amphibian powered with a 230 h.p. Siddely *Puma* motor and with Queensland maple in its hull. After an initial flop into Sydney harbor, this airplane was rebuilt and did about 500 hours' flying. By 1927 *Widgeon II* was in the air. It was quite an airplane for those days. It weighed 6,000 pounds total, had a top speed of 130 m.p.h. and a range of approximately 1,000 miles.

Then came *Warrigals I* and *II*, two-seat general purpose military landplanes. Each looked good enough to develop into a standard military plane but two things combined to wipe out Wackett as a 1933 aircraft maker. First, Australia was in the middle of a financial depression; secondly, British aircraft manufacturers explained to the Australian government of the day that airplane manufacture was a highly technical business, requiring all the resources of a great and fully established industrial and scientific nation.

If Australia tried to develop its own aircraft industry, they said, it would find itself isolated from the main streams of new aeronautical thought. And so on and on.

Until Tugan Aircraft was formed in 1936, airplane manufacture died in Australia.

A dozen or so of the old gang went into Tugan Aircraft with Wackett. In a more highly industrialized country they might

Australian plants work 24 hours a day producing these "Wirraways." Japan's entry into war ended Aussie's reliance upon Great Britain and U. S. for its air strength.

have been lost, for their all-around knowledge was shared by many, and only in Australia was their special genius needed.

That genius was for improvisation. If a specialized material wasn't available, something else as good had to be found. If the recognized way of doing a job wasn't possible, through lack of tools, perhaps, the job still had to be done. And in finding a way out, often they found a better way.

By the time war rumors began to look like more than rumors, Tugan had built eight seven-place *Gannets*, some for Royal Australian Air Force communication units and some for airlines. Repeat orders had been won for this twin-motored (*Gypsy Six* or Menasco) high-wing aircraft when war began to seem a certainty.

Blockade became a shadow across Australia's strategic plans. The theory that airplanes should be made in Australia, of Australian materials, made sense. Could this theory be turned into practice, and in time?

First requirement was hard cash. Australia has a large-scale heavy industry; its Broken Hill Proprietary Company breaks out iron and coal from the earth, carries them through to the ships, bombs, guns and steel air raid shelters which have been included in Australia's recent exports. Its many plants—one steel plant at Newcastle contains 64 miles of roadway within its fences, and is the biggest single steel mill in the British Empire—are modern and efficient by any standard. So Australians were not surprised to learn that this company was putting up one-third of the cash in a $5,000,000 company to build airplanes.

Two great metal producing companies, a steamship firm, the Australian subsidiaries of Britain's Imperial Chemical Industries, and of General Motors Corp. (the latter took 10 per cent of the shares) provided the rest. What did surprise Australians was to find that a special mission was already touring the world to choose a suitable airplane to build. Its members were two technical officers of the Royal Australian Air Force and Wackett, who was to become manager of the corporation.

They toured the world. They saw British, German, French and American factories, bearing in mind all the time just what they wanted: a useful airplane, with the bugs worked out of it, with at least some stressed-skin construction in it so that Australia could begin its first major airplane-manufacturing project with the technique that seemed to have a stranglehold on aviation's future.

At Inglewood, Calif., they found what they wanted: an airplane which North American Aviation called the NA-33. The Royal Australian Air Force liked the airplane and, in January, 1937, ordered 40—at the time a considerable order for Australia. A small team of technicians went to Inglewood and some to an American aircraft engine plant in the east. Steam shovels began to bite into sandhills on a bay near Melbourne. Equipment, gathered from every toolmaking country in the world, is now the envy of most

(*Continued on page 104*)

# Convoy Patrol

by JOHN WILDS

*An inside look at the anti-submarine patrol being flown day and night with giant Navy patrol bombers.*

NAVY flyers from the Banana River, Fla., air station, heading out over the ocean on convoy patrol, get a grim reminder of the submarine warfare they are helping to check.

Scattered along the Florida east coast—and easily seen by plane crews—are the hulks of ships torpedoed last winter and spring when far-ranging U-boats boldly hunted their victims within a stone's throw of shore.

But weeks have passed now since the Navy shepherded lone wolf merchantmen into convoys protected by surface and air craft, and in that time not one vessel has been sunk in the area assigned to Banana River patrols.

Whether planes from here have hunted down and destroyed any submarines while playing their protective roles is a taboo subject. It may be said, however, that every flying boat takes off with a full load of depth charges—and some return with empty racks.

What is important to the country is that the Navy flyers are helping speed to their destinations merchant ships which would have been sunk in the days of free-and-easy torpedoings.

Clear-eyed youngsters operate squadrons of aircraft from Banana River's three-mile circle of protected water—probably the best seaplane landing area on the Atlantic seaboard.

Some are two-placed scout-bombers [Douglas SBD's], best fitted for inshore duties. Others are giant 20-ton Martin *Mariner* (PBM) patrol bombers—called "flying destroyers" by Lieut. Comm. G. L. Kohr of York, Pa., the squadron commander.

The navigator of a PBM-3 plots his patrol bomber's position out over the Atlantic.

They are patrol ships by night, trainers by day—for it is here that picked graduates of the Navy's Air Training Schools at Pensacola, Jacksonville and Corpus Christi learn to handle the big Martin bombers. Even on patrol, while the flying boat hovers all night over a convoy, the plane is a schoolroom. Pilots and crewmen are taught their lessons under real wartime conditions.

The writer went along on training flights and learned just how thoroughly the Navy trains its flyers. Ens. Martin Galbraith of Queens Village, New York, the instructor, turned over the controls frequently to other officers and enlisted pilots just discovering the "feel" of the powerful, highly-maneuverable craft.

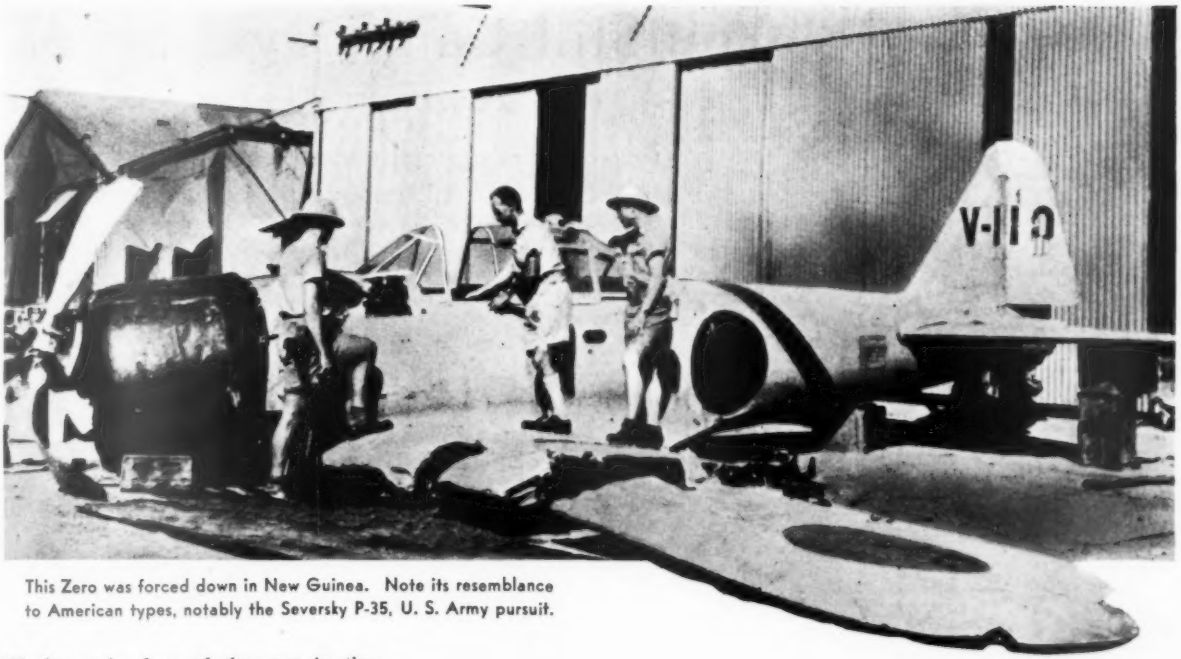
Veteran crewmen—flight engineer, radioman and others—took naps in the bunks or relaxed in their seats while students stood ship's watches. We picked up a convoy, and after the recognition routine winged overhead for photographs.

The goal of each officer is to become a chief pilot of a patrol bomber, since the pilot in charge is the supreme commander of the craft.

"It is a result of the Navy's 'Captain of the Ship' tradition," explains Lieutenant Commander Kohr. "One man has the

(*Continued on page 128*)

Martin PBM-3's (fixed wing floats instead of retractable as on PBM-1) are doing bulk of Navy anti-submarine patrol flying. Many are at Banana River, Fla., air base.



This Zero was forced down in New Guinea. Note its resemblance to American types, notably the Seversky P-35, U. S. Army pursuit.

# THE ZERO

## by REX SYDNEY

*You have heard that our pilots are terrified at the sight of this Jap fighter. But the pilots themselves disagree. Here are the official facts.*

IN the early days of the war in the Pacific, American Army and Navy flyers paid with their lives because our Intelligence services did not know in advance that the Japs' Zero fighter plane could out-climb and out-maneuver the best of ours in service at the time.

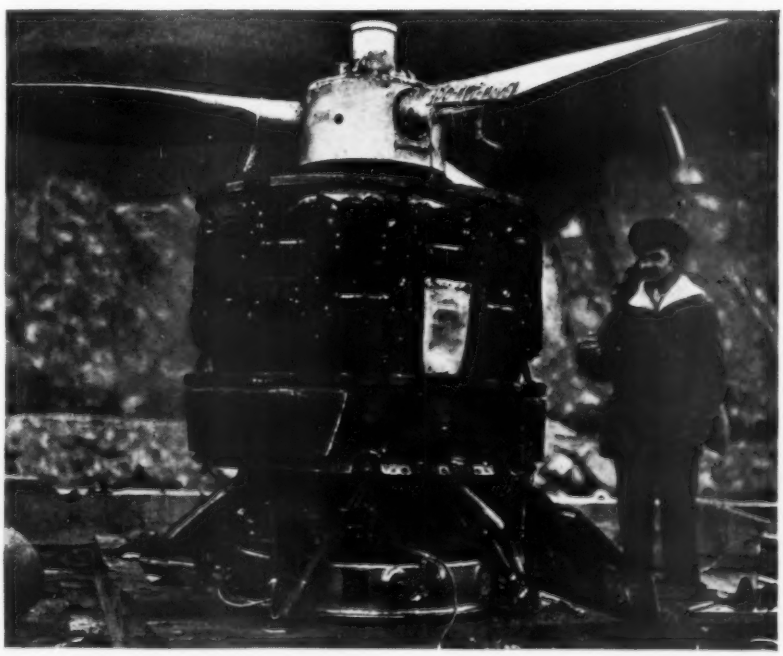
It is no military secret that the performance of the Zero, or "Navy Naught" as it is sometimes called, had American strategists worried and still is a matter of grave concern not only to the strategists but to the pilots who have to tackle them in the air.

However, in a carefully-guarded little room in the Navy Department building in Washington, where the combat reports of our pilots and all sorts of related air intelligence are given meticulous study, one of the analysts folded bony fingers which once had manipulated the controls of many a Navy battle plane and summed the situation up in one sentence.

"All we hope," he said, "is that the Japs will just keep on building Zeros."

There you have the Navy's attitude toward the menace of the fabulous Jap plane, flamboyantly dubbed the "wonder plane" by headline writers impressed by initial reports of its prowess. The Navy knows the Zero is tough but it also knows its many weak spots and feels secure in the knowledge that American flyers have held their own in the majority of contacts with the Zeros and that, when armed with the latest type of fighters already coming off the assembly lines, they will have unquestioned mastery.

Such optimism may sound like nothing but wishful thinking, but actual combat operations have proved otherwise. Perhaps the hardest part of the fight was won when American pilots realized and accepted the obvious fact that, with the planes they had at hand, they could not

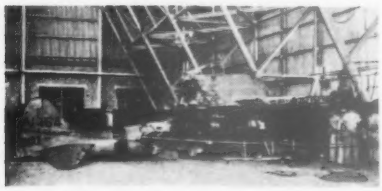


This engine and propeller from a Zero shot down in Alaska are close American copies.

"dog-fight" the Zeros and hope to get away with it. Consequently, although they were hopelessly outnumbered when they roared into battle over the Philippines and later over Java and Australia, they developed tactics designed to overcome the Zero's advantages in climb and maneuverability.

This is a 20 mm. cannon from a Zero shot down during Japs' attack on Pearl Harbor.

Knowing that their early model Curtiss P-40's, with service ceilings of barely 20,000 feet, were outclassed by the Jap fighters which could climb to 35,000 feet, the American flyers strove to capitalize on the superior speed and firepower of their ships. When the opportunity offered, they would make one "pass" at the Zeros, try to get home a good burst from their chattering .50 caliber machine guns and then break off the contact. No aerobatics — dog-fighting tactics — for them. Just the old hit-and-run method, and with their speed of around 350 m.p.h., they could easily get away from the 315 m.p.h. Zeros. More often than not, fortunately, the strategem worked and American fighter squadrons were able consistently to knock down more Zeros than they lost of their own planes. The trouble in those heartbreaking early days was that the Japs were able to withstand their losses in planes—and keep on com-



Another Pearl Harbor Zero. This one was shot down at Ft. Kamehameha Dec. 7.

ing—whereas the United Nations ultimately were forced to give up because they lacked the shipping (and the time) to bring in replacements for their plane losses.

When reports of the startling performance of the Zeros first began to trickle in

(*Continued on page* 90)

# You Still Can Travel by Air

by ROWLAND CARTER

*Priorities are a problem to air travelers today, but not nearly so much as you are led to believe.*

WHEN the Army took over about half of all the airliners and imposed a system of priorities giving precedence in air travel to war officials, ferry pilots, munitions producers and to military cargoes it seemed likely that for the duration the run of the mine business man was going to have to rely strictly on ground transportation.

Announcing a 72 per cent reduction in one line's New York-Washington service, a national capital newspaper reflected a widespread impression in predicting that henceforth "few beneath the rank of admiral, general, or Bethlehem Shipbuilding company president will get plane seats."

Actually, it has not worked out that way at all. For the time being, all the priority passengers are being carried, and a substantial proportion of seats are left over for the mere civilian. The airlines are eager to get the word around that they are still in business at the same old stand.

Not that air travel is the same as before Pearl Harbor, any more than are most other public activities. To be sure of a seat it is more imperative than before to make reservations two or three days in advance. And even then you can not always be sure. But that is true for much railroad travel as well.

John Q. Public, summoned to Chicago, New York or elsewhere for an urgent business conference which is not sufficiently concerned with the war effort to warrant priority certificates for the conferees, has to bear these points in mind in planning to make the trip by airline:

At the booking office it is advisable to obtain some informed advice as to the ebb and flow of war traffic, and to plan to favor the time of day and week between the peak loads.

If no space is available, there remains a chance to profit by a last-minute cancellation. The Government and the airlines are urging that notice of cancellation be given in all cases, and at least three hours before scheduled departure time.

Any sleep at night will be in a seat. There are no more sleeper planes. They are working for the Army now with folding berths and such ripped out to make room for cargo that has to be moved in a hurry.

Reservations are on a contingent basis. After the ticket is actually bought, and the engines are about warmed up, there is always the chance that somebody with a priority certificate will come dashing up and John Q. will have to surrender his seat, whatever the annoyance and inconvenience to him.

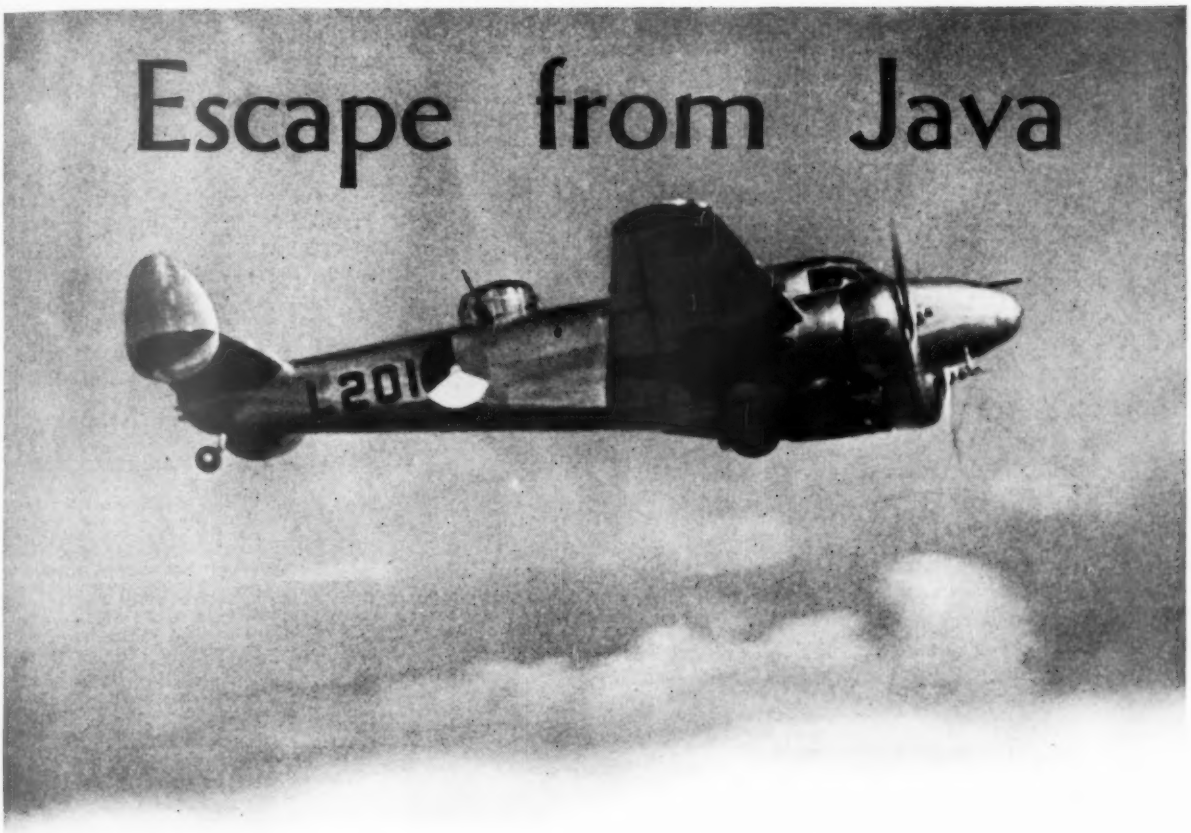
Finally, at some way point enroute, the air passenger may be notified that he will have to climb out, wait for a later plane or complete his trip by train, because another priority holder has shown up. But the chances are only one in six or seven that this will occur.

That, in outline, is the current situation, and amid war uncertainties there

(*Continued on page* 85)

Reservations should be made well in advance, otherwise air travel can be had "as usual."

# Escape from Java




The Lockheed "212" in which the author and three companions escaped the Japs.

## by Sgt. Pilot D. L. Jones

Royal New Zealand Air Force

*An abandoned American-built plane, patched with tail of another, outflew Jap pursuers.*

***This dramatic report of one of the war's most fantastic odysseys was written by Sergeant Pilot Jones to his parents in Cashmere, Christchurch, New Zealand. The heroism and resourcefulness of the participants was matched by the performance of their craft, a converted Lockheed "212," damaged and abandoned by the Netherlands Indies Air Force under Japanese attack. The plane was the first "212" ever built, being a military version of the "12."***

WE left Durban some time in January in an old cargo boat. We knew it was going to Singapore, so we were expecting to see some fun before we landed.

The fun didn't start until up the coast of Sumatra to Singapore. There were three ships in the convoy, ours being the smallest. All of a sudden 27 Japanese bombers came over and dropped a stick of bombs among us. None of them hit us, so I think it was a 50-50 proposition, because we didn't hit any of them.

Everything went all right until we were about to go into Singapore, when over came about 50 of the blighters. They started with high-level bombing and then low-level bombing, and finished up by dive bombing us in German *Stuka* dive bombers [presumably Junkers Ju-87's], and at the same time machine-gunning us.

We had 26 attacks on our ship, and I counted four bombs which landed within 12 feet of us. One of the other ships had received a direct hit between the funnels, but she managed to keep going.

We were the last convoy to go into Singapore and one of the last to leave. We were there for three days, and then came out on the same boat on which we went in. There weren't any planes for us to fly so there was no use in staying. Anyhow, the Japanese had already landed on the island and the evacuation already had reached its full force.

The trip out wasn't as bad as going in, but even so it was bad enough. We landed in Batavia and went to a camp where we stayed for awhile, and then were shifted to a camp in a place called Buitenzorg, about 35 miles from Batavia. We were waiting there, hoping to get some planes to fly. It soon became obvious that we were not going to get any.

When the Japanese began attacking the island in earnest we could see we were going to have a hard job getting out of the country. They issued us rifles and ammunition with the idea of making a stand somewhere. Sort of "backs to the wall" stunt. The idea didn't appeal to us much at all, so a few of us got to working on our own. The trouble seemed to be they were short of transport to shift the camp, so half a dozen of us jumped into a car and went in to Batavia to see if we could pick up any lorries.

Batavia by this time was a deserted city. The Japanese had landed troops on each side of it. All round the docks there were sunken vessels which had either been bombed and sunk, or scuttled. The Dutch had sunk a large vessel across the harbor mouth to stop any boat from getting in.

We found some lorries after awhile, but the trouble was, none of them would go (which was why they had been left). In the end, the others managed to get some going and left without me. I got mine going some time later. After a lot of trouble, I got back to camp.

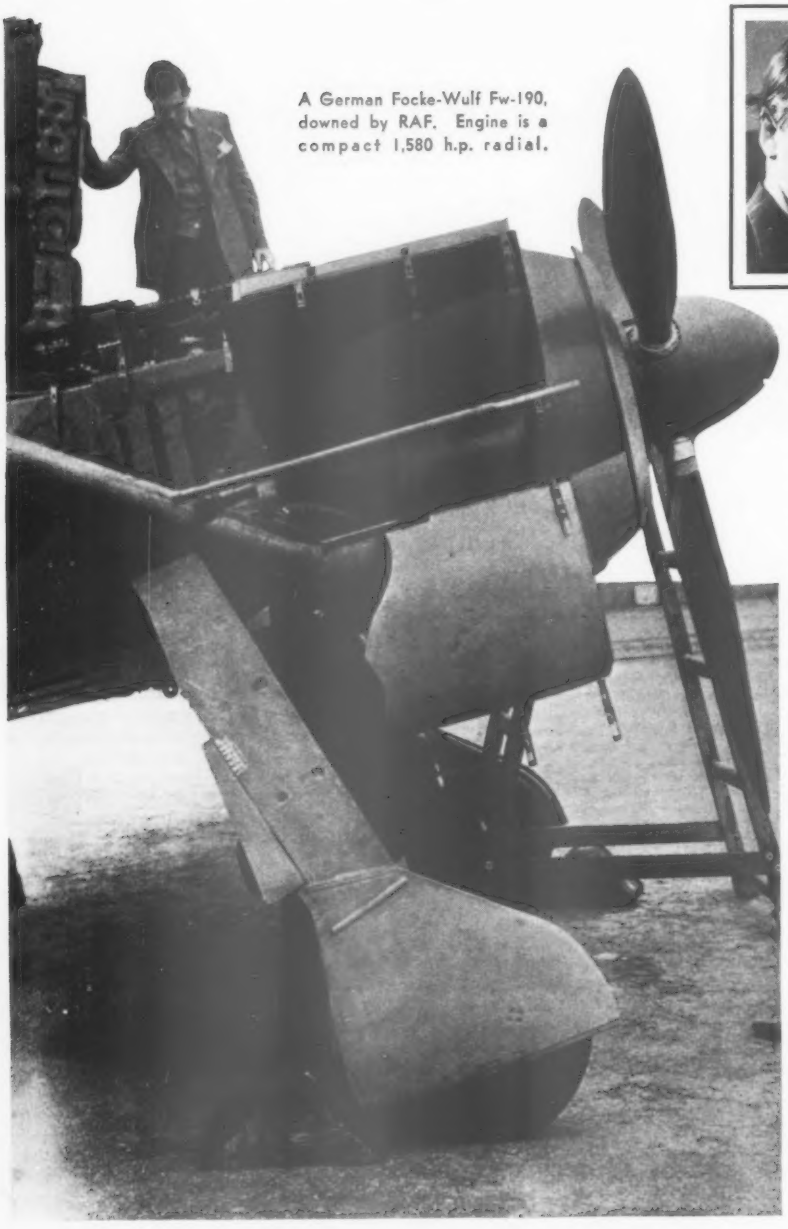
At 4 a.m. the next day we were awakened and told to get moving, as the Japanese were down the road. Fortunately, a few transports had come up, and they were able to evacuate the whole camp. We got to a camp in the town of Garoet,

(*Continued on page* 70)

# "Report From London"

by OLIVER STEWART

*An experienced observer reviews the status of our dive bombing technique, long opposed by Britain's Air Staff, and praises its deadly striking power.*



A German Focke-Wulf Fw-190, downed by RAF. Engine is a compact 1,580 h.p. radial.

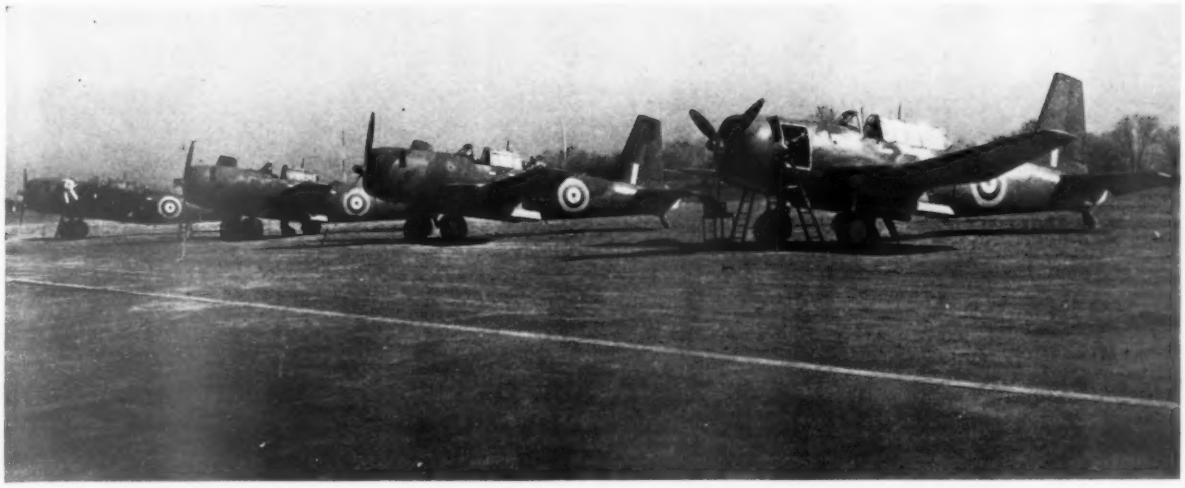
***Mr. Stewart is the editor of the British publication "Aeronautics." He also serves as commentator on aviation matters for the British Broadcasting Company and as aviation writer for the London "Observer." A pilot in the first World War, he was awarded the Air Force Cross for his part in early experimental dive bombing. Born in 1895, he joined the Middlesex Regiment in 1914 and transferred to the RFC in 1915. He was credited with downing seven enemy planes and was awarded the Military Cross.***

ATTENTION has focussed mainly on long-range strategical bombing. The great raids on Cologne and other German cities were the first cause of this and since then the statement by Air Marshal Sir Arthur Harris has intensified interest. There has been as a result a great deal of talk about the possibility of knocking Germany out by long-range bombing.

It can be predicted with a certain amount of assurance, however, that attention will eventually swing back to close support bombing, and it is about this that there is the greatest difference of opinion in Great Britain at the present time. Close support bombing may be defined as bombing designed to prepare the way for the advance of land forces. It has its counterpart in naval warfare, but for the moment I confine myself to discussing the land aspect—and especially the aspect concerned with dive bombing.

There has been more vigorous dispute about the value of dive bombing than about almost any other tactical operation. The Royal Air Force has not, during the present war, been in favor of dive bombing. In 1939, the Air Staff was definitely against it. Yet before that the Royal Air Force had done a great deal of development work—mainly with Hawker *Hart* aircraft—on dive bombing both for land and for sea targets, and when war started in September, 1939, some of the Fairey *Battle* squadrons that went to France as part of the Advanced Air Striking Force were practiced in the technique of dive bombing.

But even so, the official air force view was opposed to it. It remained opposed



The author sees an important future for aircraft like these RAF Vultee "Vengeance" dive bombers.

to it during the German successes in France and elsewhere. It refused to be deflected by the successes achieved by the German dive bombers. It argued always that the dive bomber is highly vulnerable to fighter aircraft and that it is in itself a type whose duties can be better performed by other machines.

In spite of the Royal Air Force view, however, the Ministry of Aircraft Production, believing that the need for dive bombers existed and being supported in this by army views, ordered from the United States a number of dive bombers in July, 1940. This was during the period that Lord Beaverbrook held the position of minister. Even after this order had been placed, however, the Air Staff's anti-dive bomber views found repeated expression not only in official documents but also in such unofficial newspapers and other publications as were ready to present the official view.

My own opinion is and always has been that dive bombing will become obsolete just as soon as but no sooner than the bomb. In other words, I believe that the Air Staff was mistaken in rejecting the dive bomber as a means of giving close support to land forces and also as a means of co-operating with sea forces. It is worth here putting the two sides because of the extreme importance that American opinion should have the arguments before it and should make its own decision as to which argument is right.

In 1918, I was engaged on experimental flying for the Royal Air Force and I did a certain amount of work in the early development of dive bombing. The theory has remained exactly the same today as it was then and it may be stated thus:

(1) The dive bomber launches its bomb on a path that nearly coincides with the sighting path.

(2) The sighting path nearly coincides with the flight path of the aircraft.

(3) The dive bomber gives its bomb an initial impulse in the approximate direction of the target.

(4) The dive bomber approaches the target at close range before releasing its bomb.

(5) The bomb launched from the dive bomber is given an additional impulse towards the target equal to the speed of the aircraft.

Now take these points separately and contrast them with the case of the level bomber. In the level bomber the bombardier sights in a direction totally different from that taken by the aircraft. He sights at a steep downward angle while the aircraft is flying horizontally. Therefore points (1) and (2) show a sharp difference between the two methods of launching a bomb. The level bomber bombardier sights in one direction while the bomb leaves the aircraft travelling in a totally different direction. It must thereafter curve over and down as it moves towards the target. In brief, the bomb launched from the level bomber goes round a corner towards its target whereas the bomb launched from the dive bomber goes almost straight.

Now take the third point. The level bomber throws its bomb in a horizontal direction and if it is flying at 300 m.p.h. it gives it an initial impulse of 300 m.p.h. horizontally. The bomb gathers speed as it curves over and down and the extra speed it will acquire depends on the height of the launching. But the fact that the initial impulse is in the "wrong"

(*Continued on page* 92)

Because it lands at more than 100 m.p.h., the Fw-190 needs its extra wide tread landing gear.

Frames to hold the precision-ground lenses must be gas-soldered together.

# PROTECTING PILOTS' EYES

## by Dr. E. D. TILLYER

Research Director, American Optical Company

*Flying and bombing are more accurate because the eyesight of our military airmen is well guarded.*

***A Bureau of Standards worker in 1911, Dr. Tillyer originated the first standard Naval specification for periscopes and gun sights. During World World I, he made it possible for the U. S. to manufacture telescopic sights for the French 37 mm. cannon, substituting domestic optical glass for the French type, in which unobtainable barium was needed. In 1924, he culminated 18 years of research by developing a lens which could be corrected for marginal astigmatic and focal error. In his invention of deep curve lenses, he made a valuable contribution to aviation safety by providing visual protection for pilots.***

THE eyes of our human eagles are vital in the effectiveness of our warplanes. Optical research has developed glare-protection goggles which are probably the most efficient in the world in minimizing visual strain and fatigue. These aviation goggles reduce the sun's glare, absorb dangerous invisible rays and help make flying and bombing more accurate.

"Glare" is a very much misused expression. To the layman's mind "glare" simply means high illumination, which is not the entire story. It actually means a light of such intensity appearing near the direct line of sight of an eye adapted to a certain illumination, as to cause discomfort. In automobile driving at night, the eyes are adapted to very low levels of illumination (less than one foot-candle). Headlights of an approaching automobile producing a spot of illumination of many thousand foot-candles will then produce glare. This change of glare by misplaced light decreases rapidly if the eye was originally adapted for higher illumination. A bright summer day illumination of thousands of foot-candles is not fertile ground for glare. The discomfort in this case is caused by the excess of radiant energy incident upon the human eye. This condition becomes greatly intensified with the size of the solid angle subtended by the intensely illuminated area. Large, highly illuminated areas such as stretches of sand, snow, water, horizon and pavement are

The spectacle type goggles, of special design, are for our Air Forces pilots.

good examples. If this angle subtended by the illuminated area increases 10 times, the volume of incident radiant energy increases approximately 100 times. For this reason large quantities of radiant energy, while their per cent unit content of ultra-violet may be small, may readily produce pathologic conditions of the eye. It is obvious that a reduction of five per cent or even 10 per cent of this total impeding energy cannot be of any real value. Experience indicates that a total energy reduction of at least 30 per cent is needed in outdoor protection lenses if they are to assure comfort.

The natural protective mechanism of the eye is sufficient to adapt it to ordinary intensities of illumination. However, when intense infra-red radiation is present, the sensation of heat which follows gives a quick warning and consequently it is not so likely to cause injury. But the presence of ultra-violet radiation is not felt at the time of exposure and is only revealed by the discomfort and suffering which develops a few hours after the real damage is done.

In view of the fact that the invisible rays are of no aid to vision, it is wise to minimize the risk of injury, in questionable cases, by wearing glasses or goggles which cut down glaring light and absorb the invisible rays.

The first really scientific attempt in an organized field to control light emanations was undertaken in 1909 by Sir William Crookes who, as a member of the Glass Workers Cataract Committee of the Royal Society, attacked the problem of eye protection. Crookes made several hundred experimental glasses and, in 1913, after four years of arduous labor, produced a glass of sage green color with good infra-red absorptive properties; also a glass for ordinary use which cuts out ultra-violet and which today bears the name of the famous English inventor.

At that time a glass with cut-out in both ultra-violet and infra-red, while still retaining complete visual transmission, was a chemical impossibility. In a paper, "The Preparation of Eye-Preserving Glass for Spectacles," read by Crookes before the Royal Society, he stated:

". . . The ideal glass which will transmit all colors of the spectrum, cutting off the invisible rays at each end, is still to be discovered. As far as transparency is concerned however, it will not be an unmixed advantage for the sought-for glass to be quite clear and colorless. The glare of strong light on white cliffs, expanses of snow, electric light, etc., is known to be injurious to the eye and, therefore, a tinted glass combining good obstruction to the heat radiation and ultra-violet rays is the best to aim for."

In the face of these findings, research scientists of the American Optical Company, Southbridge, Mass., undertook ac-

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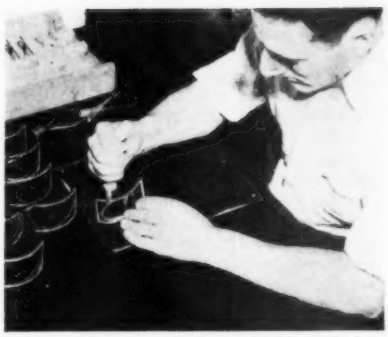
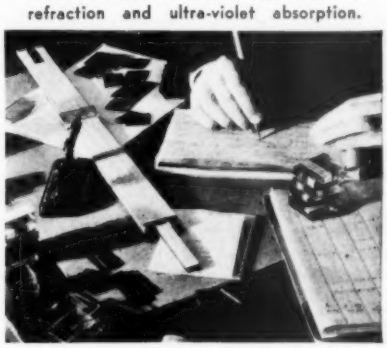


Using diamond cutter, a highly skilled operator cuts aviation lenses by hand.

Scientific tests determine the index of refraction and ultra-violet absorption.



# AIR POWER and the SECOND FRONT

by CY CALDWELL

AIR MARSHAL SIR ARTHUR HARRIS, chief of the RAF Bomber Command, told the German people by radio that RAF and American bombers would bomb their land to bits, city by city. "You have no chance," he told them in German. "Soon we will be coming over every night, every day—rain, flood, or snow—we and the Americans."

Could he back up his words? And how soon was "soon"? Harris' broadcast was assailed in the House of Lords, where it was described as silly nonsense, an imitation of the Goebbels technique, so bombastic that Mussolini might have made it. How the Germans reacted has not been reported. But that Air Marshal Harris is well on the way to making good his threat must be apparent to the German people if not to the House of Lords.

The 1,130-plane raid on Cologne last May has been followed by other heavy raids on Dusseldorf, Hamburg, Saarbrucken, Bremen and scores of other targets. About 700 bombers blasted Dusseldorf, hundreds struck at other cities. And in all of these raids the proportion of four-engined bombers to lighter bombers is growing, and hence the weight of bombs dropped per plane. A total of 3,000 tons of bombs were dropped on Cologne, six times the tonnage dropped on London in a day and a night during the attacks in 1940; 10 times the amount that the Germans dumped on Coventry. Week by week and month by month the tonnage must increase. With the rising American production it is not too optimistic to believe that the raids of 1943 will make those of this summer look like a mere prelude.

Such considerations lead many advocates of air power to the conclusion that bombing alone could smash the will-to-war of the German people, could destroy the physical ability of the Reich to build airplanes, tanks, guns, and other equipment, and provide the synthetic oil without which the German war machine must grind to a stop.

That is an idea that invites acceptance by the peoples of the peace-loving and war-hating democracies: the idea of a war relatively inexpensive in loss of life. The war, they say, will be won by the sacrifice of a few thousands, or perhaps a few tens of thousands of brave and highly trained young men. This is the age of the specialist, especially of the air specialist; and expert pilots, bombardiers and gunners will win the victory without the necessity of millions of soldiers facing death on the ground. Simply defend on the ground; wage the offensive in the air. Victory must result. So declares the air enthusiast.

However, while this could be—granted, of course, that we gain and hold air supremacy, or practical mastery of the air over Germany—the cold hard fact is that during the course of this war no victory on land, and no gain of territory anywhere on the face of the globe has been won by air power alone. No exceptions to this rule are Norway and Crete, where air power exerted the greatest effect and undoubtedly was the vital decisive factor. Both were air invasions; Crete wholly so, Norway partly so. But at the climax troops were landed to take possession and occupy. Some of these troops were parachutists and air-infantry, a part of the air force and not of the army. Yet while they were in the air they were merely passengers; the moment they landed or were landed from the transports or gliders they functioned as infantry. Hence while Crete and Norway are often thought of as being captured by air forces, actually they were captured by air and land forces working as a team.

The point to note here is that Germany, at the beginning of the war the most air-minded nation in the world, never contemplated the use of air power alone to win the victory. In the Battle of Britain in 1940, the Nazis were held to the use of air power, only; and they failed utterly to annihilate the numerically weaker RAF and then, as nearly everyone believed at the time, abandoned the invasion plan because of that defeat by the RAF. In view of later events, however, the attack on Russia, is it not more reasonable to assume that it was not only the small RAF that stopped the invasion, but also the very considerable threat of a huge Russian Army mobilized on Germany's borders, ready to spring to the attack when the Germans were committed to an all-out air, sea and land attack on England? It is the considered opinion of many military experts that Britain was saved in 1940, more by the threatening existence of the Red Army than by the heroic defense of the RAF. (Of course, that statement will sound treasonable to the air power extremists!)

The gains of the Japanese on land were made, in every instance, by the judicious use of air, land and sea power. And they always had enough of everything to accomplish the job until the Coral Sea and Midway battles knocked them back on their heels and sent them reeling groggily homeward. But those were sea-air battles, and have no bearing on a discussion of bombing Germany, and winning a victory by that method.

In the struggle between Germany and Russia both depended primarily upon armies, with air power used in support. It is inconceivable that the Red air force alone could have prevented the German army from capturing Moscow, or that the German air force alone could have stopped the Red army from marching to Berlin. It was the combination of army opposing army, air force opposing air force, that made for a balance between the contending nations, even though the weight last year, as again now, has been on the side of the Germans. And it is, I think, highly significant of the light in which Germany and Russia view air power to note that in the present campaign neither side has gone in for what the British call "strategic" bombing—by which is meant the planned destruction of vital objectives far behind the lines. On the contrary, both the Germans and the Russians have used their air power almost solely in army support during this critical summer campaign. And why? Because they know, by the bitter experience of war, and not by theory, that armies take and occupy territory, and pass on from that to occupy further territory, denying it to the former holder.

In considering the second front in Europe, it is well to remember that man is a terrestrial animal. He lives and has his being upon land. He is neither a fish nor a bird; and while he may tarry briefly on the sea, and much less briefly in the air, he must return to the land. In neither the ocean nor in the air can he support life indefinitely. If he is to survive at all he must have land; and the way to get land, in this air age as in past ages, still is to plant his feet upon that land, dig in and hold on, no matter who wants to push him off.

That, in short, is what the Germans have done in Europe, what the Japs have done in Asia and the islands. It's all very old stuff, countless centuries old, and the only new thing about it now is that some of the warriors have taken briefly to the air, to assist their fellows

(*Continued on page* 141)

# 'INTRUDER OPERATION'

## by Sq. Ldr. J. A. F. MacLachlan

*Squadron Leader MacLachlan already has been awarded the DFC with bar. In France he shot down six enemy bombers in four days; over Malta he destroyed two Italian warplanes. He himself was shot down by a Messerschmitt Me-109, a type for which the "Hurricane" of that day was far too slow. He lost his left arm in that crash, but was flying again within 15 days.*

I'M afraid the dangers and hazards of flying on night offensive patrols have been rather exaggerated. Certainly the average intruder pilot is not the cat-eyed, carrot-eating killer that the press sometimes makes him out to be. Most of us are too fond of our mornings in bed to go flying around in the daytime. Personally, sleeping in the sun appeals to me infinitely more than chasing Me-109's at 30,000 feet. Give me a moonlight night and my old *Hurricane* and you can have your *Spitfire* and dawn readiness. We've no formation flying to worry about and no bombers to escort. In fact, nothing to do but amuse ourselves once we've crossed the French Coast.

I must admit that those miles of Channel with only one engine bring mixed thoughts, and one can't help listening to every little beat of the old *Merlin* as the English coast disappears in the darkness. I always get a feeling of relief and excitement as I cross the French coast and turn on the reflector sight, knowing that anything I see then I can take a crack at.

We have to keep our eyes skinned the whole time, and occasionally glance at the compass and clock. As the minutes go by and we approach the Hun aerodrome, we look eagerly for the flare-paths. More often than not we are disappointed. The flare-path is switched off as soon as we arrive and up come the searchlights and flak. But if you're lucky it's easy. The other night I saw the Jerries when I was still some distance away. They were flying round at about 2,000 feet. I chose the nearest and followed him round. He was batting along at about 200 m.p.h., but I soon caught him and got him beautifully lined up in my sights before letting him have it.

The effect of our four cannon is incredible, after the eight machine guns I have previously been used to. Scarcely had I pressed the button when a cluster of flashes appeared on the bomber and a spurt of dark red flame came from its starboard engine. The whole thing seemed to fold up then and fall out of the sky, burning fiercely. I turned steeply to watch it crash, and as I did so I saw another Hun about a mile away, coming straight for me. In half a minute he was in my sights, and a second later his port fuel tank was blazing. I gave him another short burst for luck and then flew beside him.

A moment before he hit the ground I could see trees and houses lit up by the dark red glow from the burning machine. Suddenly there was a terrific sheet of flame, and little bits of burning Heinkel flew in all directions.

I was beginning to enjoy myself by this time and flew straight back to the aerodrome to find another. Unfortunately, all the lights had been switched off, and though I circled for some time I found nothing. So I cracked off for home. I looked back once and could still see the two bombers burning in the distance, and a few searchlights trying vainly to find me.

Well, when your fuel and ammunition

(*Continued on page* 138)

*An unpublicized division of the Royal Air Force has developed a technique of aerial sniping to harry the foe on home ports.*

The loss of his left arm provided MacLachlan with this insigne inspiration.

# FROM HEADQUARTERS

by Lieut. Col. HAROLD E. HARTNEY (A. F. Res.)

Harold E. Hartney

WE are already half way through the autumn of 1942 and the Axis have not yet won this war!

This is the best news from headquarters that could be written, for it means that *we* will win this war!

The most significant development of the last month has been the universal recognition of air power. William B. Ziff's book, *The Coming Battle of Germany*, seems with its logic and its broad basis to have sold the last die-hard. It would be fatuous in wartime to join in the chorus going about Washington now, that "everyone is trying to get aboard the band wagon,"—air power—but to a degree this is correct. Kaiser and his cargo plane proposition may have met with discouragement, but he, too, helped to awaken both the public and the Government agencies to a recognition of what is in store for this world and for civilization as and when air power has won the war.

The Army Air Forces have grown far beyond all expectation. From one Post alone of the American Legion (Aviators Post No. 743), no less than 152 officers are already on active duty, and this includes one lieutenant general, two major generals, four brigadier generals, nine full colonels, twenty-three lieutenant colonels, fifty-eight majors and fifty-five captains and down, all officers. September 15, 1941, I attended a meeting of this Post in New York City and one member got up and said, "Forget it, boys! We old codgers will never be called up or given a chance—this is a young man's war!" That member now is in Africa and the other 151 are scattered all over the globe. If anyone thinks things are not moving fast down here, he is all wrong. Air Service Post (No. 501) has likewise contributed some 20 per cent of its smaller membership.

* * *

The freezing of manpower as applied to aircraft industries by Assistant Secretary of War Robert P. Patterson, insofar as voluntary enlistment will be prohibited to employees of aircraft factories, indicates a wise and just decision in this regard and is looked upon favorably here. It is perfectly obvious that if we are to have 10,000 planes a month production, as Wendell Willkie announced on his recent visit to Turkey, somebody has got to make them. Underlying this situation is the human desire to choose one's own destiny if possible, and enlistments from the aircraft industries group undoubtedly spring from a desire not to be drafted. This is understandable, but on the other hand this balancing of manpower in our all-out effort will be solved in due time. Everybody will have his job to do, and he will do it where it is considered he will be of the most value to the Government. This may not suit the individual's idea sometimes, in his own estimation of what constitutes value, but requirements are exacting these days and we must all pitch in and do our share regardless of what we personally might think about it.

* * *

As we write this, the first loss of *Flying Fortresses* in raids over Europe is reported. The record these ships are piling up on the European front compares in like degree with that of this ship's performance in the Pacific. The Boeing B-17E is driving the Goering "nuttier than a fruit cake," and his orders to "stop those things at all costs" indicates the deep concern felt by the German high command. The Japs could have told Herr Goering what he was in for, but we doubt they've had either the time or the inclination. Nine raids over a hot front without a loss of a ship is a record no nation has hung up before, and if this performance indicates the ratio of losses to be expected, then the B-17E is truly a winged savior. They have proven they can take on the best the Luftwaffe has to offer. To the crews of these ships goes the country's gratitude, for they are really raising hob with the enemy.

* * *

Got a kick out of the report that American and British crews are busily swapping equipment. This is only history repeating itself. Reports have it that the Yanks prefer the British flying boots to their own and swap whenever they get the chance. The British, on the other hand, like the low cuts of our issue and enviously eye our leather flying jackets. It is said that on the basis of reports of this character, some changes may result in our flying equipment to conform to pilot's and crewmen's desires. This happened in World War I. It was difficult to distinguish between an American and British flying officer at the time of the last Armistice.

* * *

The famed *Lancaster* is here, and from all reports this plane really is something. A demonstration model was flown over here by Captain Clyde Pangborn, who landed the big ship at Bolling Field. Washington newspapers gave it a big play and we were lucky enough to see it come in. One certainly is impressed with the size of the plane that has done so much to blast Germany in recent deep raids. To begin with, the *Lancaster* is a production marvel. Only eight months were consumed from the time original blue prints were available until she was in the air. The *Lancaster* is not as fast

(*Continued on page* 38)

## Honor Colin Kelly

THE name of the first American air hero of World War II will live on the Famous Flyers' Wall of the International

"Corky," son of first U. S. air hero of the war, affixes his dad's wings to wall.

Shrine for Aviators at Mission Inn, Riverside, Calif., as well as on the pages of history. The name is that of Capt. Colin P. Kelly, Jr., the Army flyer who, on December 9th, sank the Japanese battleship, *Haruna*, in Philippine waters, then crashed to his death. Colin P. Kelly III, "Corky," the small son of the famous aviator, assisted by his mother, affixed his father's wings to the wall. The wings, as well as the others on the wall, are of handwrought copper, about 13 inches across, and bear the inscription "Colin P. Kelly, Jr.," and the date "December 9, 1941."

It was over 10 years ago that this unique roster of famous airmen and women was begun, and the signatures now number over 50. Among the signators are many who have made the United States outstanding in aviation achievement. Each pair of wings bears the autograph of the flyer who has been invited to honor this International Wall and also the date of the placing of the wings. Among those of fighting fame are Capt. Eddie Rickenbacker, the ace of aces of World War I, and Brig. Gen. J. H. Doolittle, the first to bomb Tokyo in World War II. Among others of the U. S. Air Forces are Brig. Gen. William E. Kepner of stratosphere fame and the recipient of many honors for heroism in World War I, and now the 4th Interceptor Commander; Lieut. Gen. H. H. Arnold, Maj. Gen. Frank M. Andrews, Maj. Gen. B. D. Foulois, Brig. Gen. Dellos C. Emmons, Brig. Gen. Jacob E. Fickel and Brig. Gen. H. A. Dargue.

The Famous Flyers' Wall at Mission Inn adjoins the St. Francis Chapel, named for St. Francis of Assisi, for many centuries the patron of birds and now adopted by aviators of many lands as their patron saint.

END

# FOR IDENTIFICATION

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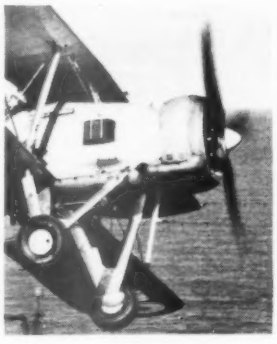

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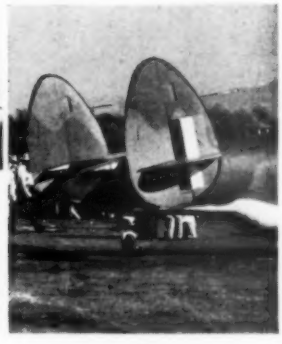
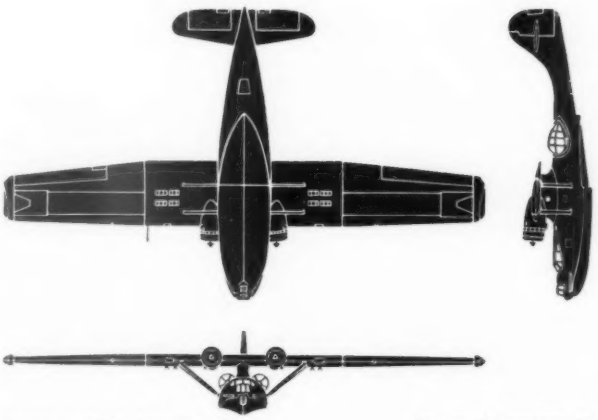


8

The planes are: 1. Vultee "Vengeance." 2. Heinkel He-113. 3. Stearman NS or N2S. 4. Westland "Lysander." 5. Fairey "Swordfish." 6. Short "Stirling." 7. Aeronca L-3. 8. Lockheed "Ventura."

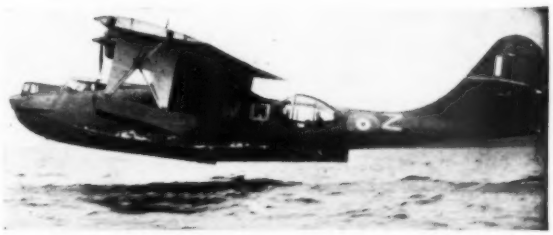
## CONSOLIDATED "CATALINA"

Patrol Bomber



*Courtesy "The Aeroplane"*

FLYING, November, 1942

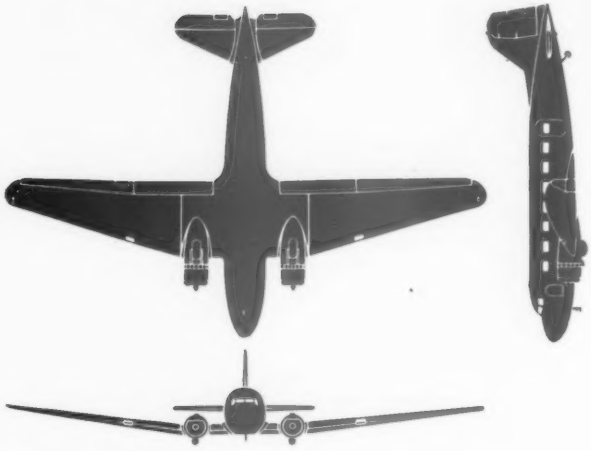


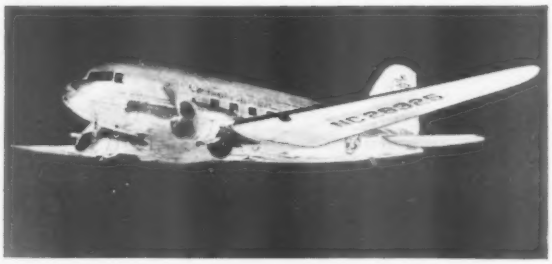
PERTINENT FACTS: The veteran flying boat of them all, the *Catalina* was so named by the British. Recently, the U. S. Navy adopted that name for its PBY's. Basically a seven-year-old design, the *Catalina* currently is powered by two 1,200 h.p. air-cooled engines which give it a top speed of 190 m.p.h. Maximum range is 4,000 miles. Span is 104 ft., length 65 ft. 1 in., height 18 ft. 6 in. Armament normally is six .30 caliber machine guns, although the U. S. Navy may have replaced most or all of these with .50 caliber guns. An amphibian version of the *Catalina* has retractable tricycle gear.

WHAT TO LOOK FOR: A high, parasol-winged monoplane, the current *Catalina* has a large bulging blister on each side of the fuselage, enabling the gunners to cover the tail. The wing is externally braced. The *Catalina* was the first aircraft to have wing tip floats that retract outward into the tips, the floats themselves forming the wing tip. The large center section is perfectly rectangular, although the wing panels taper slightly outward. The tail surfaces are cantilever in construction; the elevators are unusually large in relation to the other control surfaces.

# DOUGLAS DC-3

## Cargo and Transport





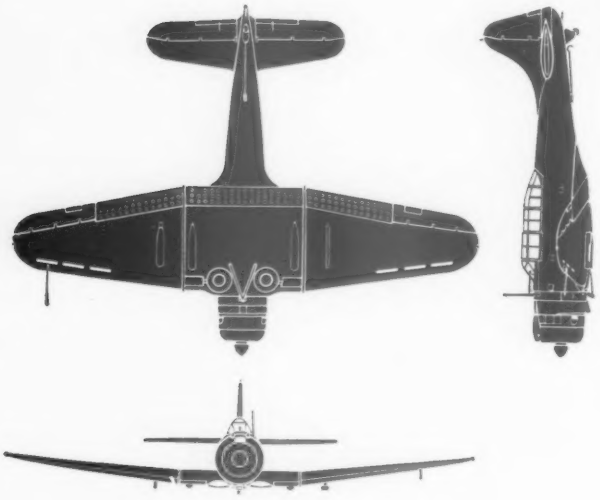
PERTINENT FACTS: Probably the best-known, most widely used airliner in the world, the DC-3 today is the backbone of the Army's vast Air Transport Command as well as U.S. commercial airlines. Two versions of this ship in the Army are known as the C-47 and C-53. Generally, the DC-3 is powered by two 1,100 h.p. Wright *Cyclone* engines, which gives it a top speed of 220 m.p.h. Maximum cruising speed is 194, stalling speed is 67 m.p.h. Normal range is 2,125 miles. Span is 95 ft., length 64 ft. 5½ in., height 16 ft. 11½ in. Wing area is 987 sq. ft. Empty weight is 16,600 lbs., gross weight 25,200 lbs.

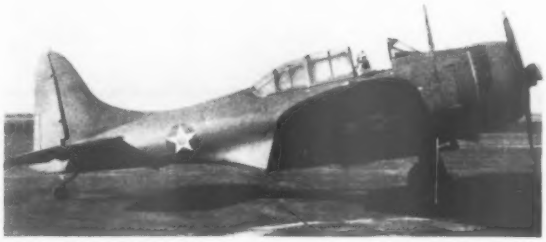
WHAT TO LOOK FOR: The DC-3 should not be confused with its smaller, sister DC-2. The DC-3 is a conventional cantilever low-wing cabin monoplane. When overhead, it is most quickly recognized by its distinctive wing, which has sharp leading edge taper from the center section out, but a straight trailing edge. Wing tips are rounded. In the side view, the DC-3 is quickly spotted by its tail. The vertical stabilizer is faired forward along the top of the fuselage almost to the cabin door. The landing gear retracts backward into the engine nacelles, the wheels projecting noticeably when retracted. The tail wheel does not retract. The *Cyclone*-powered DC-3 can be identified by the engine cowl which has a sort of half-moon metal section in front of the upper cylinders.



# DOUGLAS "DAUNTLESS"

## Scout Bomber



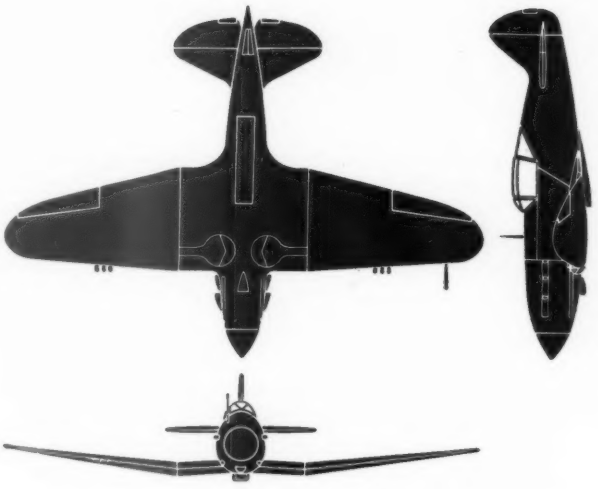


PERTINENT FACTS: One of the most widely used combat aircraft in its class, the *Dauntless* (SBD) got that name from the Navy; the Army calls it the A-24. Primarily carrier-based, the *Dauntless* has flown in most of the operations against the Japs in the Pacific. An excellent example of the modern American dive bomber, the *Dauntless* is powered with a 950-1,000 h.p. *Cyclone* engine. Span is 41 ft., length 32 ft., height 13 ft. Armament details have not been released. The hinged arm directly under and ahead of the pilot's cockpit throws the 500 lb. bomb clear of the propeller arc during dive bombing attack.

WHAT TO LOOK FOR: A two-place, cantilever low-wing monoplane, the *Dauntless* is quickly identified by its wing with the perforated diving brakes and built-in slots, and by its distinctive, gracefully faired tail. The cockpit hood is of conventional design. The wing panels, from center section out, have equal taper to the rounded tips. The radio mast is standard on the left side of the fuselage, just ahead of the windshield. The landing gear retracts inward, folding flush into the center section.

## I-18

Fighter



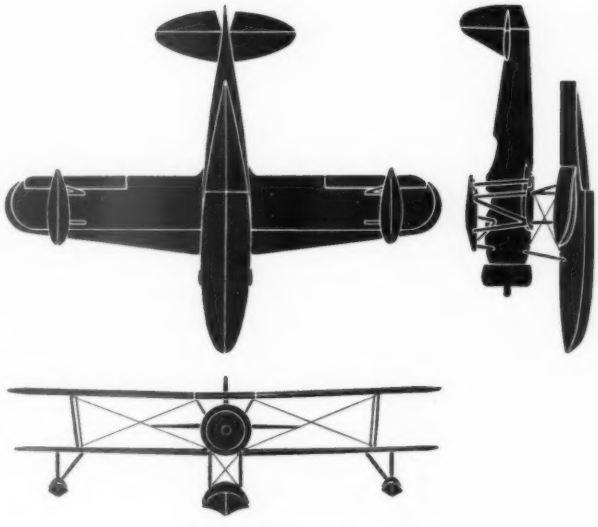
PERTINENT FACTS: Known variously as the I-18 (the official Russian designation) or the MIG-3, supposedly derived from the names of Russian Foreign Trade Commissar Mikoyan and Gurievˇ, the plane's designer. It is reported to have several armament combinations, the most logical being four machine guns (.30 or .50 caliber) and two 20 mm. cannon. Span is 37 ft. 6 in., length 31 ft. 2 in., height 10 ft. 6 in. Its 12-cylinder, liquid-cooled, 1,200 h.p. engine is reported to give the I-18 a top speed of 360 m.p.h. at 13,000 ft. Gross weight is 6,200 lbs. This fighter is supposed to use plywood construction extensively, most of the wings and tail structure being built of that material.

WHAT TO LOOK FOR: The I-18 has certain external characteristics that resemble both the British *Spitfire* and the American P-40's. But it has many distinct features of its own that make it fairly easy to identify. The reverse-gulled center section can be quickly seen in the front view, with marked dihedral in the wing panels from the center section outward. In plan form, the wing has slight leading edge taper, sharp trailing edge taper and rounded tips. Both wing and tail surfaces are fully cantilever. Note particularly the deep fairing from the trailing edge of the center section to the fuselage. The landing gear retracts inward, folding flush into the center section.

FLYING, November, 1942

## NAKAJIMA T-95

Reconnaissance



PERTINENT FACTS: An old single-engined biplane still used by Jap battleships and cruisers, the Nakajima T-95 resembles very closely the U.S. Navy's old Vought *Corsair* of nearly 10 years ago. The T-95, according to Naval sources, has a span of 36.1 ft., length, 27.9 ft. and its wing area is 330 sq. ft. The engine is a nine-cylinder Kotobuki air-cooled radial which develops 600 h.p. at 11,000 ft. Top speed at that altitude is 160 m.p.h. Cruising speed is 135 m.p.h., range is 500 miles carrying a crew of two, 220 lbs. of bombs and 120 gallons of fuel. Armament is two 7.7 mm. machine guns, one fixed and firing forward, the other flexible and fired from the rear cockpit.

WHAT TO LOOK FOR: A conventional biplane, the T-95 has a single center float and fixed wing tip floats. The top wing follows the Vought pattern with its sweepback cutaway center section. The lower wing has straight leading and trailing edges; both wings have rounded tips. The tail surfaces are of conventional design, being externally braced with wires. The engines is cowled after the fashion of NACA design; the two cockpits are open. Wings and fuselage are fabric-covered.

FLYING, November, 1942

# AIR EMPIRE

by ROBERT S. MORTON

Pan American's "Capetown Clipper" leaving New York on its 18,000 mile proving flight to Belgian Congo.

*Recognized throughout the world as the symbol of American aviation's initiative, Pan Am is an intricate structure of corporate mechanism. This writer takes it apart to show us how it goes.*

Interior Secretary Ickes signs an air base license as Pan Am's Juan Trippe watches.

PAN AMERICAN AIRWAYS made history when the unscheduled around-the-world-flight of its *Pacific Clipper*, necessitated by the sudden outbreak of war in the Pacific, gave the company the distinction of being the first commercial airline to completely girdle the globe. But making aviation history and filling newspaper and magazine rotogravure sections have marked the progress of Pan American. Little known, however, is the corporate mechanism through whose structure a far-flung organization has evolved to operate one of the world's most intricate industrial machines.

Pan American Airways Corporation is not an operating company. It merely holds investments in subsidiaries and other companies whose activities are officially described as "principally engaged in air transportation over foreign and international routes." In general, the international operations are carried on by subsidiaries organized in the United States; internal services in foreign countries are furnished by foreign subsidiaries. An important exception as to ownership is Pan American-Grace Airways, Inc., the joint enterprise of Pan American and the widespread W. R. Grace and Company shipping, banking and commercial interests.

Familiar is the story of Pan American's origin in October, 1927, when it established scheduled operations between Key West and Havana—a distance of 90 miles. Today, the Pan American Airways system represents the largest air empire in the world with more than 98,000 route miles once established in regular service.

Quick to realize landplanes' speed advantage, Pan Am bought several Boeing "307's," calls them "Stratoclippers."

The pioneer effort of bridging the 90-mile route across the Straits of Florida, has grown to an eight-day 15,000-mile circuit linking all 21 of the American republics. Pan American has gone on to span the Pacific with termini at Singapore and Auckland, New Zealand. This service has been temporarily disrupted due to the war. Separate routes were successively established in China and Alaska. For more than two years, regular flying schedules have been maintained over the North Atlantic. More recently, an aerial bridge was thrown over the South Atlantic to Africa. And now still another route may be indicated for the future by the war-pursued and pioneer flight of the *Pacific Clipper*.

The various subsidiaries actually conduct the operations which fit into the pattern of giving Pan American a world-wide complexion. Latin American operations are principally carried on by Pan American Airways, Inc., the Atlantic service by Pan American Airways Company (Delaware), and the Alaskan service by Pacific Alaska Airways, Inc., all of which are wholly-owned subsidiaries. The Pacific service is conducted by Pan American Airways Company (Nevada) which finds itself a wholly-owned unit of Pan American Airways, Inc. These separate companies not only permit segregated route operations but come in handy during air mail rate proceedings with the Civil Aeronautics Board.

A typical illustration of the start of a new service may be found in the Pan American Airways Company (Delaware) acquisition of a route certificate. The company received a temporary certificate from the CAB, with the approval of the President, which authorized the carriage of mail, passengers and property from Miami, Fla., via San Juan, Puerto Rico, Port of Spain, Trinidad, Belem and Natal, Brazil, and thence to points in southwest Africa—Monrovia, Liberia, Lagos, Nigeria and Leopoldville, Belgian Congo. This new route facilitated operation of the "ferry service" for the delivery of American built planes to the British Middle East command by way of Africa. It was granted the company presumably in the interests of national defense on testimony introduced in executive session in hearings before the CAB.

Closely related with this new route are two more newly formed and completely owned subsidiaries — Pan American Air Ferries, Inc., and Pan American Airways —Africa, Ltd. The first named company is the instrument credited with the function of ferrying aircraft from the United States to Africa. The other subsidiary confines its operations wholly within Africa and is reported as making deliveries to Khartoum, Anglo-Egyptian Sudan.

This new transport service is being operated with U. S. Government-owned equipment. Pan American sold one of its planes (a Boeing 314A clipper) to the Government, which in turn leased it back to PAA for use in commercial operations. It is believed that by using Government-owned equipment, the question of landing rights and conformance with neutrality laws are simplified.

Although started as a private enterprise, Pan American has assumed the aspects of a semi-official agency. Not only has the company received substantial mail subsidies but also Federal assistance in negotiating operating rights and privileges throughout the world. In return, Pan American has carried the prestige of the United States throughout the international trade routes. At present, the company is being utilized as an agency of the Government in the development of national defense outposts.

Unofficial reports indicate that Pan American was the recipient of about $12,000,000 for airport and radio construction in Central and South America from one of the special defense funds. The War Department was credited with co-ordinating this construction program. This arrangement gives Pan American exclusive commercial use of the airports improved and constructed, with full use extended to the Army and Navy. It is difficult for the U. S. Government to build its own airports in foreign countries, but Pan American can improve its existing facilities with U. S. assistance as well as provide new airports where required. It would not be surprising to find this same

A Lockheed "Lodestar" of Panair do Brasil at Santos-Dumont airport, Rio de Janeiro.

arrangement in effect in Africa. When all the shooting is over, these improved and augmented facilities may be expected to become a permanent part of Pan American's fixtures.

The extent of mail subsidies paid Pan American are clearly revealed by official figures. From 1928 to the end of the 1942 fiscal year, about $123,000,000 has been appropriated for U. S. foreign air mail routes—virtually all of which may be attributed to Pan American. This mail income has consistently comprised better than 54 per cent of its total revenues. Table 1 shows the trend of these mail payments and indicated subsidies as represented by the difference between Post Office foreign air mail payments and revenues. As the detail for the 1940 fiscal year is the most recent available, an analysis of the breakdown for this period will illustrate the accuracy of the supporting table. All foreign mail routes, with the exception of the one operated by the Canadian Colonial Airways, were operated by Pan American. For the 1940 fiscal year, the Post Office paid $12,424,722 for its foreign air mail service and received only $7,272,130 postage and other revenues from this activity. As Canadian Colonial received only $257,890 of the total revenues, it hardly distorts the conclusion that $5,152,592 represents the subsidy to Pan American for this period.

According to Post Office Department figures, the Government realized a profit on only two foreign routes for the 1940 fiscal year: Miami-Cristobal, $552,285, and Miami-Havana, $49,544. While the transatlantic service lost about $228,500 for the year, the trend since has changed and it is known that this operation has returned a profit to the Government. Late last year, Pan American was reported as carrying about 30 per cent of the transatlantic mail.

Only recently, the CAB ordered a downward revision in the air mail rates to be paid Pan American for its transatlantic operations. The previous base rate received by the company was $21,600 per trip. The new rate, fixed by the Board's order of this past September, is 44 mills per pound mile, to be effective as of December 13, 1941, the date the Board instituted proceedings. The CAB found that Pan American's operations have been on a commercially self-sustaining basis since that time. While no estimates are currently available as to the extent of reduction in mail revenues to the company, it is believed this loss will be rather substantial.

The Latin American routes have long been the most profitable of Pan American's operations. According to CAB officials, Pan American mail rates have been excessive. The charge was also made that in estimating its capital investment in Latin American operations at $18,582,000, the company failed to make deductions of over $8,000,000 for equipment already depreciated on its books. Further, it was alleged that for each of the past two years, the company made an operating profit of over $2,000,000 in its Latin American service and thus realized a return of 20 per cent on its actual investment.

In another final rate action, the CAB

(*Continued on page* 80)

# A Unified Service

## by MELVIN J. MAAS

Congressman from Minnesota, now on active duty with U. S. Marines.

*Old-fashioned red tape is seriously hindering our war effort. The author suggests important changes.*

OUR military and Naval forces are not organized for modern warfare.

The present organizations of both the Army and the Navy, with their air branches, have been a mushroom growth out of an ancient form of organization adopted in the days of sailing vessels and muzzle-loading blunderbusses. There is bureau upon bureau and division and office and section upon division and office and section. There is vast duplication and, at the same time, gaps in authority and responsibility. There is no actual coordination between the Army and the Navy, and even the mechanics for coordinating the two is not in existence.

The air arms of both the Army and the Navy have grown somehow, in spite of prejudice and resistance all along the line. They struggled against prejudice and tradition. The advance of aviation was hindered just as gunpowder was resisted in its day. Steam had a very difficult time to supplant sails. Whether the generals and admirals of the old school like it or not—and they *don't* like it—air has become the prime striking force. It is not merely an auxiliary to the Army or the Navy; it is not merely the eyes of the fleet, nor yet even just an umbrella for the fleet; nor is it merely elongated artillery for the Army. Today air is the potent weapon of both offense and defense.

War in almost every theater of operations is fought today by a composite force of surface vessels, undersea vessels, mechanized ground troops and air. To meet modern battle conditions a makeshift device has been created called a "task force." It is an elastic organization made up of whatever elements are needed (and available) and in whatever strength is deemed necessary. The question of command—that is, whether the task force commander shall be from the Navy, the Army or the air—depends on each individual circumstance. Personalities and the influence of those in Washington determine the make-up of the task force.

Modern war conditions make it mandatory that we completely revise our traditional ideas and thinking about the organization of our military and Naval forces. If we are to win the war—at least if we are to win it as quickly as possible and with a minimum expenditure in manpower and resources—we must have one master, over-all war plan. Every battle, every engagement, every action must be a part of that one major plan and must be geared to major strategy. Not only must the whole of the military forces be so organized and directed as to make every move a step in the one direction, but the nation must be so organized as to contribute, to the maximum degree, to that plan. There must be a co-ordinated training program starting with the raw recruit, through the officer personnel; and the entire procurement program must be based upon this one master plan. Every shot that is fired, every bomb that is dropped, every torpedo that is loosed must be a part of this plan. Side issues, spectacular battles, or raids that do not contribute to the major plan must be foregone, regardless of their publicity value at home. Not a life should be risked, not a dollar spent and not a bullet fired, regardless of the temptation, unless it is part of this master plan or will contribute to the furtherance of the master strategy.

This can be brought about, however, only if there is one over-all planning agency with complete authority over

(*Continued on page* 124)

# REPAIR UNIT

An RAF unit in the Middle East, equipped to work on both American and British craft.

*Serviceable fighting craft emerge from the RAF's "crash heap" and resume their place on the line, thanks to Britain's efficient repair unit system.*

ONE of the outstanding features of the war in the air has been the development by Great Britain's Ministry of Aircraft Production of a vast repair organization which has been directly responsible for the return to combat service of an unrevealed but amazingly high percentage of RAF aircraft damaged in battle, in forced landings, or otherwise.

During the visit to England of Lieut. Gen. George H. Brett of the U. S. Army Air Forces, a special chart was prepared at his request, illustrating the construction of an RAF unit devoted to the repair of aircraft. General Brett has been second in command to General Douglas MacArthur, stationed in Australia. It is probable that the organizational setup and procedure of a typical RAF repair base may by now be operating under General Brett's former command, and performing the same miracle of salvage for the American Air Forces.

The RAF unit pictured on this page is equipped for the repair of planes and engines of either British or American manufacture, and to the rebuilding of aircraft from "crashed" or salvaged parts. (The term crashed is used within the RAF to denote *any* plane under repair, no matter how slightly damaged.)

The Ministry of Aircraft Production's repair organization farms out its work to both civilian contractors and RAF repair bases. The point of having the RAF as well as commercial organizations perform repairs is to develop within the RAF skilled repair crews to accompany the RAF anywhere in the world, however remote from factories, machines and civilian labor the strategy of the moment might demand.

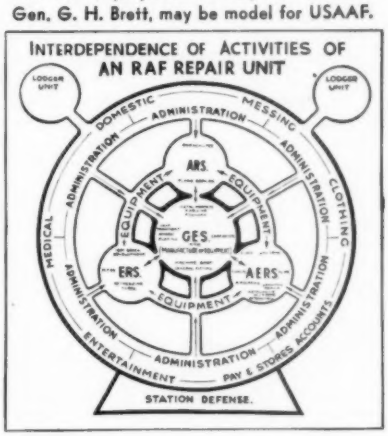
Thousands of men and women of the RAF and the WAAF operate a typical RAF repair unit. A good many of the men have spent years in the service, but the majority of both men and women had little or no experience in engineering, instrument-making and the other trades involved before the war.

"In fact," said a unit commander, "we have everything from a dressmaker to a pawnbroker, including jewellers, gardeners, doctors, teachers and lawyers, and could be a self-sufficient community as

(*Continued on page* 145)

Damaged by debris during air battle, this spinner will be fixed, replaced on plane.

This chart, prepared at request of Lieut. Gen. G. H. Brett, may be model for USAAF.



Mechanics are selected through use of scientific questionnaires compiled by psychologists and personnel experts.

# Technician Trainers

by

Maj. Gen. WALTER R. WEAVER

Commanding General, Air Forces Training Command

*Getting the right man for the job is a fine science in the Air Forces. The technique has been developed until it is nearly foolproof.*

THE Army Air Forces Technical Training Command is using the "square peg in the square hole" principle in building the army of technicians for the United States Army Air Forces, the greatest the world has ever seen. In the problem of training hundreds of thousands of mechanics, the men who will keep the nation's combat aircraft in peak condition, the Technical Training Command is using aptitude tests to discover the American soldier's latent talents and educating him in the work he can do best.

The selection of mechanics and technicians for ground crews of the Army Air Forces is founded on scientific questionnaires compiled by psychologists and personnel experts who have worked steadily since the last world war in preparation for the problems that confront them today. From almost a naive beginning, the classification and selection of mechanics and skilled technicians by aptitude tests have grown into a complicated and scientific process.

When I first had the job of training airplane mechanics for the meager air force of World War I, I purchased toy erector sets and handed each prospective student a screw driver, a set of directions, and told them to go to work. The men who finished first were the ones selected for airplane mechanic training. That was 1917!

It was this simple beginning that started the Classification Division of the Technical Training Command. Once again I am training mechanics for the Air Forces, but on a greater scale than we ever imagined in 1917. Since that time the process of selecting individuals for the Air Forces mechanic's and technician's courses has evolved into aptitude tests designed to indicate quickly a man's greatest possibilities. There are no toy erector sets. Today the Technical Training Command in its replacement centers at Sheppard Field, Tex.; Keesler Field, Miss.; Jefferson Barracks, Mo., and Miami Beach, Fla., can determine through written examinations what job the modern

soldier can best accomplish. It is possible to know if a soldier would be better at radio than mechanics, or if he has the natural aptitude to be an aircraft machinist, metal worker, Link Trainer specialist, welder, parachute rigger, teletype operator, power plant, instrument, or propeller expert, electrician, aircraft armorer, photographer, bombsight or power turret mechanic, administrative or supply clerk, weather forecaster, or any of the 22 different courses taught at the schools throughout the Command.

In earlier wars there was no need for such highly skilled men as there is in the present conflict. Even if specialists had been required extensively it is doubtful if such a system of selection would have been employed as has been developed and is now in use. Today the airplane specialist is imperative for the conduct of the war. The most apt individuals must be detected and quickly trained.

A plane that cannot fly is one of the most useless things in the world. And planes will not fly unless they have sufficient ground crews of experts for their proper maintenance.

The purpose of the Technical Training Command is summed up in these few words: To train in the minimum amount of time the maximum number of mechanics and technicians. Too, these men must be trained to as near perfection as possible, for skill and accuracy are second only to the training program itself.

With the objective of training ground and flight crews for our fighting aircraft rapidly as one of the major requirements for the victory, the Technical Training Command has expanded to meet the job set for it. In less than a year it has grown from a handful of Army bases to more than half a hundred fields and schools from coast to coast and Gulf to the Canadian border, webbed around the headquarters at Knollwood Field, N. C.

One of the many classrooms for the aptitude tests given to the men of the Air Forces Replacement Training Center at Jefferson Barracks, Mo. There are four such centers.

The recent months have been filled with feverish activity. Replacement centers at Sheppard Field, Keesler Field, Jefferson Barracks and Miami Beach had to be increased and expanded. Plans for technical schools at Lincoln, Nebr.; Goldsboro, N. C.; Madison, Wis.; Buckley Field, Colo.; Amarillo, Tex.; Gulfport, Miss.; Sioux Falls, S. D., and others, were rushed to completion.

Already functioning training fields include technical schools at Chanute and Scott Fields in Ill.; Lowry Field, Colo., and Sheppard and Keesler fields. At these fields the 22 different courses for airplane mechanics and technicians are taught. These schools are turning out, in ever-increasing numbers, the vast army of skilled soldiers that will keep the fighting aircraft constantly prepared for combat duty.

The 22-course curriculum is not taught at all the schools, however. Each school specializes in different courses. For instance, Chanute, Keesler and Sheppard fields train aircraft mechanics, engine and plane overhaul mechanics, machinists, welders, metal workers, carburetor experts, electricians, propeller, instrument and Link Trainer experts, and parachute riggers. Lowry Field specializes in armorers, clerks, photographers and bombsight maintenance. Scott Field is the radio university of the Army Air Forces, a school for radio operators and mechanics.

Maj. Harold C. Poyer, classification officer at Sheppard Field, Tex., and his civilian consultant, Dr. Wendell L. Gray, examine the questionnaires of new applicants.

Often playing much the same role as the unsung hero who runs interference for the player who makes the touchdown, the radio operator is, nevertheless, vital to modern warfare. Without him there could be no blitzkrieg, no adequate defense against it. Radio communication is necessary in co-ordinating attacks, and keeping alive the essential plane-to-ground contact that so often spells the difference between a safe return and a crash.

For every plane in the Air Forces today, with the exception of pursuit ships, two radio men are necessary. Theirs is a part without glory, without headlines, without fame and often without appreciation from the civilian population. But on these men depend many things. Pilots depend on the radio beam to get them home safely. They depend on perfect radio signals and messages to steer them in the correct maneuvers. The role of

radio operator is one to be played with pride. At Scott Field the soldier is trained in complete laboratories in which he becomes thoroughly familiar with all branches of this exacting science. It is just one phase of the Technical Training Command program.

At Lowry Field, the photographic school, the laboratories are considered the world's finest and so it is with the other schools. The courses themselves are as thorough as the laboratories are well equipped.

Another example of the exactness of the training course is that of the parachute rigger. Students become expert in the folding and packing of the 'chutes that may mean life or death to a fellow soldier. They are taught the importance of checking the 'chute every 10 days and repacking them every 60 days. Like the mechanics and other technicians, the thought is endlessly repeated: upon the ground forces largely depends the life of the men in the skies. It is, therefore, important to select the proper men for these jobs upon which others rely for their safety.

In Link Trainer courses students are taught to service and maintain the Link Trainer, a mechanical device simulating actual flight conditions in which the pilot receives, on the ground, instruction in instrument flying.

The teletype maintenance course affords training in the repair and maintenance of this important message-transmitting instrument, used extensively by the Army Air Forces.

Training the vast army of mechanics needed by a rapidly expanding Air Force is not confined to the Army Air Forces Technical Training Command's own schools. There has been within the year incorporated in the training school chain a considerable number of privately owned civilian mechanic schools as auxiliary training units. These "air institutes" located in almost every large city in the nation have become important adjuncts to the Technical Training program, and even though they were incorporated into the Technical Training Command fairly recently they are already turning out classes of skilled mechanics in increasing numbers.

Recently more than 20 leading aircraft manufacturers producing planes and engines for the Air Forces have organized post-graduate classes in their factories. Here "advanced" mechanics now have an opportunity to study the latest technical developments under the guidance of the aviation industry's engineers and familiarize themselves with the newest types of combat planes, engines, propellers, gun turrets and other developments. From these factory schools mechanics, upon graduation, serve as key men in flight and maintenance crews in combat zones and training fields.

The care in selection of personnel for these courses begins early in the life of a soldier. It is only a few hours after induction into the service, at a reception center, that he is given the important general classification test. The assignment of a man to the Technical Training Com-

(*Continued on page* 120)

# Towed Air Transports

by Maj. LEWIN B. BARRINGER
Glider Specialist, Army Air Forces

**Gliders in the Army are going out of the experimental into the practical stage. A leading authority discusses the plan.**

"GLIDER calling tower. Glider calling tower." "Okay, glider, go ahead." "Glider to tower. Have released from tow at 3,000 feet one mile east of field. Will be coming in in a few minutes. Warn all aircraft."

This radio conversation, with slight variations, is heard several times nearly every clear day now over Wright Field, the Army Air Forces great materiel center near Dayton, O. The glider which is being flight tested is either a big nine-seater troop transport or an even larger ship which will hold 15 men with full equipment. This huge troop-conveying glider, designed by Waco, weighs 3,000 pounds. The voice speaking through the mike is usually that of Col. Fred R. Dent, Jr., chief of the fast growing glider unit at the field.

It was Colonel Dent who a year ago first took up in a glider over famed Harris Hill at Elmira, N. Y., the man responsible for the glider program of the Army Air Forces, Lieut. Gen. Henry H. Arnold. Colonel Dent, then a major, was a member of the first class of Air Forces pilots to receive training in gliders.

A part of the experimental engineering branch of the Materiel Command, the glider unit is charged with developing all of the equipment to be used. Its hard working group of engineers and pilots includes several well known in gliding circles including 2nd Lieut. Chester J. "Chet" Decker. Chet, a recent graduate of the Air Forces advanced flying school, was a former national soaring champion and is one of the four Americans holding the highest rating for civilian glider piloting, the "Golden C."

This group of officers at Wright Field is only one of a growing number of Air Forces units carrying on some part of the glider program. These units are scattered pretty well all over the United States.

To understand this program let's first go into the "why" and then the "wherefores." The fundamental reason for building numbers of transport gliders and training the pilots to fly them is to greatly increase our air transport capacity. By towing two big gliders behind each transport we will approximately double the carrying capacity of that airplane.

The two Air Forces Commands largely concerned with the program so far are the Materiel Command which develops and procures the gliders and the Flying Training Command which trains the pilots to fly them. The work performed in the program by the former is split into two categories, experimental and production. The first has already been mentioned. The second is carried on by the production engineering branch.

The officer in this branch charged with carrying out most of the details is Maj. Ernest W. Dichman. Major Dichman was an Air Corps pilot in the last war and later became an engineering officer at McCook Field. He returned to civil life and served as sales manager for an eastern aircraft manufacturer until his recent recall into the service. He now has the job of whipping into shape a group of light airplane, furniture, refrigerator and piano manufacturers to produce the big gliders.

The Flying Training Command with headquarters in Fort Worth, Tex., shoul-

(*Continued on page* 142)

Two Waco gliders are towed off at Wright Field. That in the lead is the nine-place XCG-3, the larger one is the 15-place XCG-4. Note latter's towline on top of cabin.

# "I FLEW WITH THE RAF"

Hawker "Hurricanes" landing on British field after intercepting and repelling a Nazi bombing attack.

*The drama of aerial warfare remains as great as in World War I, but now the battles are fought by teams, not individuals.*

by WENDELL H. PENDLETON

Pilot Officer Pendleton behind the 2-inch thick windshield of his RAF "Hurricane."

THE secret of successful aerial warfare today lies in the teamwork of the flying units, not in the individual feats of daring by ace pilots.

The British Royal Air Force and the German Luftwaffe employ a practically identical style of aerial strategy. And all of it is based on co-ordination.

As an American member of the RAF (part of the time with the famous Eagle Squadron 71) I have 450 "fighting hours" to my credit. I write of what I know and experienced, not of what others told me.

The names of famous aces of the World War? Richtofen, Udet, Billy Bishop, Rickenbacker and many others come to mind. Their individual feats of daring in the air were glorified. How many "aces" can you name today? I dare say very few, although this may be called, in many respects, an "air" war—with many more times the number of planes employed than in World War I.

Speed, altitude and teamwork are all-important in today's air-blitz. The British *Hurricane* and *Spitfire* are more maneuverable than the Messerschmitt. But that means very little in World War No. 2. The Messerschmitt usually was able to climb above the British craft and also holds the advantage in speed.

I say this with reservation. When I received my honorable discharge from the RAF a short time ago, having been knocked out by sinusitis aggravated by high altitude flying, the British were sending a super *Spitfire* into the air which probably matches the famous Messerschmitt Me-109F. And the *Flying Fortress* flies as high as any Messerschmitt, if not actually higher.

Let me give you an example of a modern day aerial battle. A British squadron is flying at an altitude of say 25,000 feet, with a single "weaver" 1,000 feet higher, and another 500 feet below. The squadron is in "search" or battle formation, which consists of the 10 planes in the main body flying in "V" formation exactly like a flight of wild geese. The planes are spaced four wing spans apart, with the squadron leader farthest in front —exactly like the old gander that heads a flight of honkers.

Suddenly the weaver up above speaks into his transmitter, "Snappers at 6 o'clock!"

The weaver dives down and falls inside the "V" of the squadron and at the rear. The bottom weaver rises and takes his place beside the top weaver.

Two squadrons of German planes are bearing down on us from directly behind at an altitude of 27,000 feet. Above them at 30,000 feet are three more squadrons. The two nearest German squadrons take a line astern formation, one directly behind the other and dive at us. They are coming at a speed of 600 m.p.h., throttle open and bearing down with gravity helping. We're moving at top speed now, which is somewhere around 400 m.p.h.

We turn the noses of our planes up. The fire from the 12 guns (machine guns

Officers' mess, North Weald station, was in building at left. Private residence (right background) was to house Eagle Squadron but was destroyed by Nazi bombs.

and cannon) with which each *Hurricane* is armed converges at 250 yards. You "lead" a plane moving at 600 m.p.h. by three sight rings at that distance.

Here's Jerry. Flash! Flash! Flash! He's by, the vapor curls streaming back from his wing tips. He roars over us so near we coud have distinguished the features of the pilots if there had been time—which there wasn't. He dives by, going like hell and headed in that general direction.

You look around. Yes, the weavers are missing. Those two always have the hot seat in a scramble like this. Way back behind you, you see a couple of planes going down, a long trail of smoke following each. Two or three other planes also are falling. There's the white puffs of parachutes.

Three Jerrys. two British. Gone quicker than you can bat your eyes a half-dozen times.

That's an air battle for you as it is fought in the war today over England, France or Germany. Somebody else will have to write about the Japs.

The other three squadrons of German planes may or may not come down to attack. They probably will stay up above to serve as a threat against our squadron if it should attempt to descend on the Jerry planes that have shot below us. However, such an attack by us under the circumstances would be a great risk, and the British squadron leader usually is willing to call it quits. He's fought off superior numbers, turned back the Germans. There's no percentage in fighter tackling fighter. It's not the fighter that hurts England—or Germany. It's the bomber.

If Jerry's bombers are coming over, however, the RAF attacks and never stops attacking as long as a British plane is in the air or a bomber in the sky. And Jerry pays the same compliment to the British bombers over France or Germany.

"Blitz warfare" is the proper term when you are talking about modern aerial combat. The one perfect position for attacking is behind and above. The attack is delivered in a screaming dive, motors open full blast, guns blazing. The only defense against this attack is nosing up to meet the enemy. This maneuver gives the attacker a smaller target as he passes by and also permits the "target" to bring his own guns into action.

A premium goes to the fighter who can get above the other. There's a premium on speed as the attack is being delivered.

British planes can outmaneuver the Messerschmitt—so Jerry rarely stays to make a dogfight out of it. It's all teamwork, line astern attack, one plane whirling after the other, diving and reforming far below.

When a scramble is expected, a formation usually will hit for the ceiling, going as high as possible. Sometimes they will nose along just below the clouds. If it is possible the leader maneuvers his planes so that the sun will be in Jerry's eyes.

One of the rules of modern day aerial warfare is never to break formation. A straggler from a formation can be easily attacked by superior forces and shot down.

Sometimes a squadron leader detaches one or two sections from his squadron to attack a smaller group or individual enemy planes. After the attack, the detached sections streak for home. For instance if a squadron leader, cruising at say 25,000 feet, sees a lone enemy raider at 20,000 feet, he probably will order a section (two planes) down after it.

These planes attack, one after the other, bring down the enemy if possible, and then call it a day. They get down and get home as fast as they can. They've done their job. Straggling alone there they invite an enemy attack. And, if an attempt to rejoin their squadron should be made, the squadron as a whole is at a disadvantage while waiting on the other planes to catch up.

A good squadron leader is like a football coach. He may sit up nights mapping out new formations or studying new battle plans. When I was with Eagle Squadron 71, my squadron leader was Bill Taylor, now a lieutenant commander with the American Naval air arm. In fact, I was his No. 2 man in flight formation, which meant that he was looking after me since I was for a time a "new" man.

Taylor sometimes would give us as many as two or three blackboard lectures a week on formation and maneuvers. How a maneuver could be speeded up, what we should do under certain emergencies and so forth. He was exactly like a football coach.

But for battle, the "V" formation, based on the flight formation of wild geese, is the old standby. Both bombers and fighters use it whether in squadrons, flights or by threes.

In the last month I was with the RAF, however, on two occasions I saw a squadron of *Spitfires* flying in an entirely new battle formation. This consisted of two parallel lines, with a weaver above and a weaver below. In fact, it appeared two line astern formations, traveling side by side, each line four wing spans apart from the other.

If we should be caught by Jerry when we were out alone—or out of ammunition or with the firing mechanism out of order—there was one maneuver, our experienced leaders taught us, by which we might save our skins. Here comes Jerry down from above. Our guns temporarily are out of action. Never go into a straight dive! You are gone if you do. Jerry's usually faster, and he likes nothing better than to line his sights on a straight diving target. It's just the same as shooting at a stationary target.

Go into a downward aileron roll. With the engine going full power pull the stick hard over, one way or the other—letting the rudder alone. As the half-roll is three-fourths completed, just before the plane reaches an upside down position, bring the stick back and to the center of the cockpit. Ordinarily, pulling back on the stick pulls the nose of the plane upward. Now, with position reversed, the nose points towards the ground.

When the nose is down, ease the stick back to neutral position. Now back over to the side again, still laying off the rudder. Now you're doing a roll in a vertical position, downward. You're moving in two directions at once and at high speed. If Jerry gets you he's in luck. No sight is made that can be lined up properly on an object going in two directions at the same time.

Jerry probably will follow you down for a spell—he usually does. Sometimes, on a prey like this he follows down to the tree tops and pots at you as you hedge-hop away. But that can't be helped. The aileron roll will get you down out of the air usually with a whole skin and that's something. Or maybe you haven't been in a pickle with a Messerschmitt on your tail and your guns dead!

When Jerry surprises you and your guns are okay, turn up fast at him if you can. Get him off your tail if possible.

(*Continued on page* 112)

The flight engineer of a Pan Am "Stratoclipper" notes instrument readings on log.

# Trouble Shooters

by
IDELL D. HAYS

*The flight engineer has become an important crew member as multi-engined transports climb into substratosphere air lanes.*

ITS four motors synchronizing smoothly, the great ship skims through the clouds at 220 m.p.h.—and at 14,500 feet.

The passengers sit comfortably as the plane rises another 200 feet. It passes the 14,700 foot mark. Still they are undisturbed. Higher altitudes mean nothing to them.

There's one person aboard to whom that 14,700 foot level makes a great difference. He's the flight engineer of the ship. And because he's there, the other passengers, instead of taking oxygen through a tube, are sitting quietly in the supercharged cabin. Altitudes above 20,000 feet are the same to them as 2,000 feet to the average flyer.

Up to the 14,700 mark, the flight engineer is seeing that a cabin altitude of 8,000 feet is maintained. Immediately above that, he must keep a two-and-a-half pound differential to the air pressure outside. And in his odd moments he takes careful and constant check of the more than 200 instruments on the panel before him. That is why his job came into being.

When ships grew overnight from two-motored to four-motored equipment, the crew had to grow, also. A captain and a co-pilot have their hands full with the flying, the radio and the instruments on the smaller ships. So when the big ship was born, a new crew member was needed. Would he be a radioman, an electrician, a navigator, another pilot—or an *engineer?*

America's answer to that was a new character in aviation: the flight engineer. And the speeded up building of four-motored equipment for war needs has made his place an important one, and increasingly so.

This year, 22 young men whose uniforms have a single stripe on the sleeve, in contrast to the captain's two and the co-pilot's one-and-a-half, have been TWA's answer to this modern need. Since July, 1940, they have been flight engineers of the company's five Boeing *Stratoliners,* recently turned over to the United States Army Air Forces for a foreign courier service.

And their chief, since November, 1941, has been Ray Dunn. TWA being the only

Ray Dunn (right), TWA's chief flight engineer, checks plane prior to a test hop.

domestic airline to have used four-motored equipment and, hence, flight engineers, Ray's position is unique. (Pan American, which does have such officers on its crews, operates chiefly over the water and is not limited to domestic flight.)

Much of Ray's time has been spent in instructing mechanics for their unusual jobs. But it has been a pioneering game all along; Ray admits he has spent more time learning things himself than teaching others!

"Not only were we new at the work, but the work itself was new," he says. "We've had to study out and build up our positions as we went along."

While Ray was building up the job, he piled up some 1,200 hours in the air and about a quarter of a million miles of flight. As a team with Robert Loomis, TWA engineer-test pilot, they have more testing time in four-motored equipment to their credit than any other pair in the country.

Recently Ray had temporary flight engineer duties on a Consolidated B-24 at Albuquerque, N. M. The B-24 is a larger and later plane than the Boeing. The English version, in which RAF Ferry Command pilots were trained at Albuquerque, is called the *Liberator*.

"On the B-24," says Ray, "the flight engineer's job is vastly magnified. In all the time I flew as a crew member, I never became completely familiar with it—or ever had an instant to spare! I'd say the flight engineer in such a ship as that has fully 200 per cent more duties than in the *Stratoliner*."

Since Ray flew with the first *Stratoliner* on its initial scheduled flight, July 8, 1940, (7 hrs. 32 min. from Burbank, Calif., to Kansas City, Mo.), he and the 21 other flight engineers have kept up with new developments and made some of their own. "Many of the original charts and diagrams we brought from the Boeing factory had to be changed and corrected since 'something new had been added' almost every day! Each control panel had some additional instrument. We've had the responsibility of weeding out the flaws, and putting in our own ideas, many of which are being used on the big ships now.

"All future development in the supercharging of the cabins (my pet all along—lots of interesting kinks to be found and fixed) will likely come from what the flight engineers learn while the ships are in actual operation. They're the ones who work with it day after day, and they're the ones who know the truth about its performance—and the only ones who do!"

On his manual sketches—the originals from the factory—are dozens of marginal pencil-jottings, such as "This line is to increase air flow *only* when the outlet valve is closed" or "left hand control, vent to cabin pressure." Each represents a piece of pioneering in this field of work.

Just what *does* a flight engineer do?

Here's a professional's reply to that question: D. W. "Tommy" Tomlinson, now a lieutenant commander in the Navy, and TWA's former chief engineer, has

(*Continued on page 127*)

# Help Wanted!

by EDWARD J. GARDNER

Personnel Officer, Civil Aeronautics Administration

**Men and women from 17 to 40 are sought for jobs in the Civil Aeronautics Administration. Pay ranges to $3,800.**

LOOK at the bulletin board in any post office, where Uncle Sam runs his "Help Wanted" ads, and you'll see one listing after another of positions open with the Civil Aeronautics Administration.

On the one hand, the draft, the calling to duty of reserve officers, and the calls to other branches of aviation have depleted CAA personnel ranks and, at the same time, war duties have made it necessary for the CAA to enlarge its staff.

To close this gap, the CAA has undertaken a many-sided recruitment program, which features intensive training courses for new employees, and presents several

One duty of CAA inspectors is to check out student flyers in huge CPT program.

chances for women to make a career in aviation.

Vacancies range from trainee positions starting at $1,440 per annum to senior flight supervisors for the CAA pilot training program, at $3,800.

Air-minded young men and women from 17 to 40 may qualify as trainees for the job of junior aircraft communicator with no other qualifications than the ability to type 40 words a minute. After six months of intensive training, they will be promoted to positions paying $1,620, and may progress to jobs as chief aircraft communicator at $3,200.

They will learn to take and report weather observations, and to operate and maintain radio telegraph, radiotelephone and teletype equipment. About 75 per cent of the present trainees are women.

Training centers have been established at each of the CAA regional offices, and instructors were given an intensive course in modern training methods through the co-operation of the U. S. Office of Education and the Civil Service Commission.

The instructors attempt to give not only technical training, but to make the student realize the vital importance of his work, which has been described as follows:

"He maintains vigilance at his earth-bound station and through the magical medium of modern communication, serves those who traverse the sky by day and night—through weather fair and foul; with messengers at his command that span the world in an instant.

"His duties are exacting—responsibilities great. Safety of life and property often depend solely upon the proper performance of routine assignments; sometimes only individual initiative and resourcefulness will avert disaster.

"His loyalty must be constant—his mission never ends. Into his hands are placed tools fabricated through years of research and development. He must contribute the final and most vital link—intelligent human endeavor to the end that those who fly the air ways may do so with maximum safety."

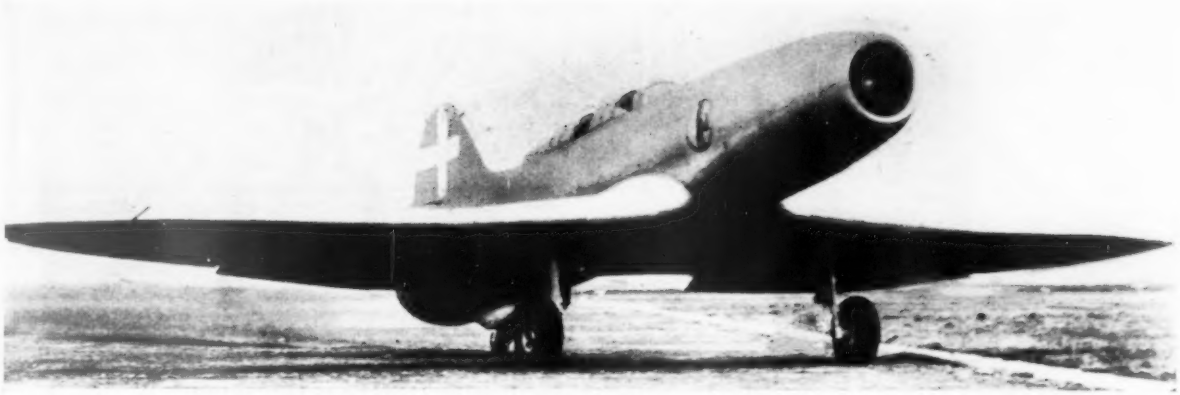
Higher qualifications are required for trainee jobs as traffic controllers on the airways and at airports. Up to 1,000 men and women from 20 to 45 will be taken on at a salary of $1,800, and after six months training may be promoted to assistant airport traffic controller at $2,000 or airway traffic controller, $2,300.

Basic requirements are high school graduation and two years of experience in the field of aircraft traffic control, operations or radio voice communications. For each year of high school there may be substituted six months of experience or 50 solo hours. For each year of experience there may be substituted two years of college, a private pilot certificate, a senior control tower operator certificate, a six month intensive aeronautical training course, completion of the CPT ground school course or 100 solo hours.

Assignments will be to the airport traffic control towers recently taken over or established by the CAA at the request of the War Department, or to the centers which now control traffic on virtually the entire 32,000 miles of Federal airways.

Among openings of still higher grade, the pilot training service of the CAA reports that it is always interested in potential maintenance, flight and ground school supervisors. Maintenance and ground school supervisors receive $3,200 a year, flight supervisors $3,500, while corresponding positions of senior grade pay $300 a year more.

(*Continued on page 128*)



The propellerless Caproni-Campini C.C.-2. Air enters duct in nose, is compressed then ejected from tail.

# POWERED BY HOT AIR

by

WILLIAM WINTER

*The Germans and Italians are harnessing the kinetic energy of jet propulsion in drive for greater speed.*

ON August 27, 1940, when the world was watching the rising fury of the air battle for Britain, Col. Mario de Bernardi, the famous Schneider Trophy pilot, made an epic flight over Taliedo aerodrome in Italy. This flight lasted only 10 minutes but the ship was a radical new design that may revolutionize high speed aircraft. The job that de Bernardi piloted that day was the jet-propelled Caproni-Campini C.C.-1.

Not much is known about the C.C.-1 except that it was an 8,000 pound single seater that took off by means of a conventional propeller, then switched to jet propulsion. Moreover, it was said to feature a pressure cockpit. Observers tended to laugh off the "flying squirt"—as the British so aptly christened it—as just another of those crackpot Italian ideas. But it begins to look as if the Italians really have something. On December 1, 1941, de Bernardi flew the C.C.-2, a two-place jet ship, between Taliedo and Guidonia (the Italian equivalent of our NACA), covering the 168 miles at an average speed of 130 m.p.h. For good measure de Bernardi toted along a passenger and a mail bag, according to reports. The really amazing part, though, was that the C.C.-2 is propellerless! This 11,000-pound low wing monoplane apparently can take off without a propeller. In six months the Italians had accomplished a trick that so far has frustrated the best brains in aviation. Our own NACA reported in 1923 that jet take-offs would require a jet heated to 2,500° Fahrenheit moving at a speed of a mile per second. Picture that around the local airport!

In the light of recent German developments along these same lines, the Caproni-Campini is getting the serious attention of warplane designers of every nation. Junkers is working on a jet-propelled airplane—of which more later—and, like as not, persistent reports of the German use of rocket power for assisting take-offs of heavily loaded ships or for temporarily boosting fighter speeds in an emergency may actually refer to jet propulsion, since considerable heat is added to the air jet. The general appearance and sound of the jet ships could cause the uninitiated to confuse them with rocket ships. Ernst Udet, who was reported killed while testing a secret "weapon," is supposed to have perished flying a rocket (or jet) airplane. In de Bernardi's own words, the jet craft are out of the dream class and are now a practical proposition. Clearly, the flying squirts are of military importance.

Hot air is ejected through this controlled outlet, providing plane's forward impetus.

Engineers say the existing engine-prop setup is approaching its maximum speeds; some entirely new means of propulsion must be developed in the near future. As speeds increase jet propulsion compares more and more favorably with propellers which lose efficiency progressively, until at about 800 m.p.h. the efficiency of jets actually surpasses that of propellers. Even on current 400 m.p.h. fighters the insignificant jets of the exhaust stacks add another six miles or so to the maximum speed. Super sonic speedsters are a possibility with jets. Here it is interesting to recall Italian interest in super sonic wind tunnels at Guidonia. But while super sonic airplanes may be just around the corner, Junkers is said to be interested in speeds just under the speed of sound. In Junkers opinion the Italians are going off the deep end in a strange new field where speeds are so great that the basic data is lacking for the streamlining or proper shaping of aircraft. The only applicable information is that of ballistics or the flight of projectiles.

In theory jet propulsion is simple. It is the oldest and simplest method of converting heat into mechanical energy. The principle of the legendary aerophile of Hero's was a hollow sphere rotated on an axle by steam jets set tangent to the circumference of the sphere. All jet pro-

pelled schemes now under consideration involve compressing air, heating it, then expanding it rapidly and releasing it rearward through a jet opening or orifice.

On the Caproni-Campini jobs the air is taken in through a large circular opening in the nose, run through a motor-driven compressor (which heats it automatically), mixed with the hot exhaust gases for further rapid expansion, then expelled through a moveable tail jet that works as both a throttle and an elevator control. Contemporary experimenters have mixed the fuel with the compressed air as it rushed through the jet tunnel and burned the mixture for increased thrust. Powdered coal, paraffin, gasoline and many

Benefit of jet propulsion is given by exhaust stacks of Hawker "Hurricane."

other fuels have been used successfully. The normal air jet alone would not develop sufficient thrust and therefore the jet must be augmented by heating and compressing the air for further rapid expansion and by careful design and shaping of the jet tunnel.

In its working principle jet propulsion is similar to rocket propulsion. The difference is that the jet ship takes its combustible oxygen from the surrounding air and the rocket ship carries its oxygen (for that matter the entire weight of all materials jetted away for thrust) in its fuel. Thus, while the flying squirts are limited necessarily to the stratosphere at best, the rocket ship is independent of altitude or air. The rocket principle works in a vacuum and, in the vacuum of space, rocket ships would accelerate indefinitely. For our purposes the fact that the jet principle actually has propelled aircraft is sufficient proof of the possibilities of rocket power, though for rocket ships a fuel is needed that will burn for sufficient length of time while developing the required thrust. The jet jobs are truly the stepping stone to the rocket planes of the future.

What makes a jet-propelled ship move? Probably the simplest explanation is to consider a waterfilled cube, measuring, say, a foot square. Physics tell us that if a certain pressure, ten pounds for instance, is exerted on any square inch of the surface of that cube a similar pres-

(*Continued on page* 94)

## AIRCRAFT OWNERS AND PILOTS ASSOCIATION

# AOPA NEWS

**The Aircraft Owners and Pilots Association, with Service Headquarters in the Michigan Square Building, Chicago, Ill., is a non-profit organization formed and composed of non-scheduled aircraft pilots and/or owners exclusively. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. The views and statements of opinion contained in this column are those of the Aircraft Owners and Pilots Association and not necessarily those of FLYING. This column is edited by the staff of AOPA for its members and other interested parties. Special releases of a more confidential nature are additionally sent each month to all registered members.**

### Instructing for Uncle Sam

Carl Bigelow, (AOPA member 7935) of the Metropolitan Oakland, Calif., unit, has called our attention to the following war work of another AOPA member.

Into a spot that normally would be filled by a man, but now vacant because of the rapidly increasing rate qualified pilot instructors are being taken into the Army, has stepped Mrs. Alma Jerman, 27, a former Red Bluff resident.

Mrs. Jerman, an ardent AOPA member and booster (AOPA 8321), has taken up her job with M. N. "Gus" Gustavson (AOPA 8073) at the Reno Sky Ranch and is doing her part in preparing young men to take their places in Uncle Sam's expanding air forces.

Although the mother of two boys, one now five and the other eight, Mrs. Jerman started flying in 1939. With her private pilot's license, she continued to enjoy trips throughout the country until war broke out. When the need for instructors became acute, Mrs. Jerman left her Red Bluff home and went to Reno, where she became a student of "Gus" Gustavson.

After completing this training, she learned the new Army curriculum and joined Gustavson's staff. From her work, Gustavson is convinced that women will do a good job in alleviating a critical shortage of private instructors.

### Drop Testing of Parachutes

The practice of sliding a dummy with parachute attached out of the cabin door of aircraft is discouraged in safety regulation release No. 113 issued recently by the CAA. There have been a number of accidents resulting from this practice involving the premature opening of the parachute during take-off and flight.

Members interested in drop testing of parachutes should obtain a copy of this release by writing to the CAA in Washington, D. C., or to the Washington AOPA Service Office.

### Confusion of Lights

Recently there have been several reports of airport control-tower signal lights which have confused pilots and which have almost led to disastrous accidents.

(*Continued on page* 119)

Mrs. Alma Jerman is teaching Air Forces pilots. Plane is a Culver "Cadet."

*Intercollegiate rivalry now is exemplified by the organization of U. S. Naval aviation "teams."*

C. G. Olson

# FLYING COLLEGIANS

by MAURICE RODDY

NAMES that are college tradition are now writing Naval aviation history as a simple idea created by Lieut. Comm. Carl G. Olson, senior member of the Naval Aviation Cadet Selection Board in Chicago, is sweeping the nation. Hundreds of young college men are trading their school letters for a pair of Uncle Sam's wings and the blue of the Navy.

It was on Memorial Day, 1941, that Lieutenant Commander Olson conceived the plan of recruiting university air squadrons that would play the game of war with the same spirit that cheered their school teams battling on the field of sports. First of these squadrons was organized at Notre Dame and, on July 14, 1941, the "Flying Irish" reported at the Naval Reserve Air Base at Glenview, Ill., for primary flight training.

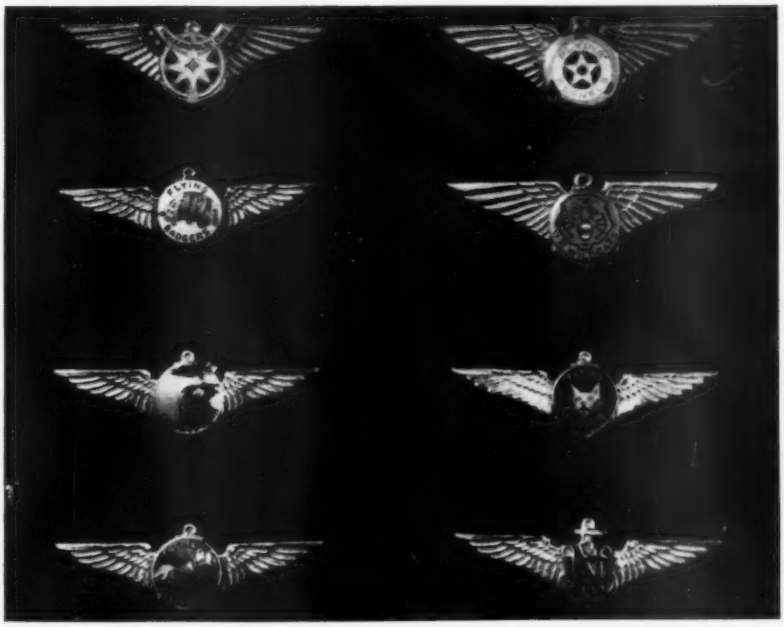
Although organized later, the "Flying Badgers" actually were first to report for flight instruction, on June 30, 1941. Composed of University of Wisconsin students, the unit was sponsored by Pat Lewis, John Schroeder and Howard Stark of the Milwaukee "W" club and Milwaukee Alumni Association. Thirty-four members of the squadron were guests of the city and speakers at the induction ceremonies included Gov. Julius Heil and the then Mayor Carl Zeidler. The Navy's new recruiting idea caught on immediately. In swift order there appeared at naval air bases the banners of the "Flying Bulldogs" (students from Franklin, Wabash and Butler universities in Indiana), the "Flying Boilermakers" (Purdue), Northwestern's "Flying Wildcats" and the "Flying Maroons" of the University of Chicago.

That team spirit must pay dividends is attested by the fact that 95 per cent of the first squadrons have completed their training and have been commissioned as ensigns. This is well above the average for all enlistees in Naval aviation.

At present all the major universities in the four-state area of the Chicago cadet selection board have their own squadrons, with the University of Wisconsin leading with five inducted units, and more on the way. In recognition of its contribution the University of Wisconsin has been awarded a certificate of meritorious service by the Navy. University authorities have cooperated willingly, more readily asssisting recruiting for these individual squadrons than for individual flying candidates.

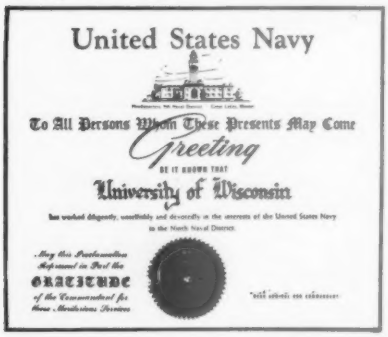
Some of the stars on the flying teams

Ten husky members of Notre Dame's "Flying Irish" squadron assume a familiar huddle.



Individual insignia add to competitive spirit as campus men seek Naval wings.

so far recruited include George Franck, All-American football star of the University of Minnesota; William and Chester Murphy, twin brothers and former University of Chicago tennis and basketball


United States Navy

To All Persons Whom These Presents May Come Greeting

BE IT KNOWN THAT

University of Wisconsin

has worked diligently, unselfishly and successfully in the interests of the United States Navy in the Ninth Naval District.

May this Proclamation Represent in Part the GRATITUDE of the Commandant for those Meritorious Services

Certificate of gratitude given colleges.

stars; Norman "Boots" Kukak, Marquette hockey star; Bus Heagy, George Benson and Ike Kepford, Northwestern gridders; Billy Roth, noted Badger boxer and Everett Kelso, Wisconsin University track champion.

As explained by Lieutenant Commander Olson, there are two major benefits attributable to squadron organization which concern the individual as well as Navy recruiting. One of the first squadron candidates to be accepted expressed the benefits to the individual well when he said:

"We feel closer together in our training period so that we are able to iron out common problems in a spirit of friendly competition and close friendship. Even the most mentally alert individual is somewhat confused by the new situations that learning to fly under the most thorough pilot training in military service makes.

"If Johnny Jones with whom I fooled around on the tennis team is around to help, the road to wings will be quicker, easier, surer and better. The teamwork of attack that is essential to successful waging of modern warfare is another very important training element that can be gained from training with an individual squadron."

From the Navy recruiting viewpoint, the glamor of the special squadron spotlights Naval aviation, and civic organizations and college officials are more willing to co-operate when the final result of their efforts is a group of Navy flyers bearing the name of their community or school.

It is pointed out by Lieutenant Commander Olson: "In cities or similar geographical areas, those first joining up go back to their home town or home block and do much to get friends to join up, so that all can be together in a special squadron. The same is true on the university campus.

"Inter-city and inter-school rivalry is brought into play. Each city and each college wants to send the biggest and most distinguished group of prospective pilots to the Navy air force in their special squadron organization. The public is generally more receptive to the various

(*Continued on page* 128)

# ✶ VERTIGO ✶

by JOHN R. HOYT

*Aviation medical research has revealed a close connection between ear physiology and crashes.*

IN a recent dive bombing attack a pilot dove his plane from 12,000 feet to about 2,000 feet in a short space of time. During his climb to altitude he had "cracked" his ears by swallowing, which decreased the atmospheric pressure in his eustachian canal, thus making it equal to outside pressure. During the dive, it was necessary to repeat the process once more because of the increased density at the lower level.

However, due to a cold or local congestion, the pilot found it impossible to "crack" his ears, and the pressure became almost unbearable. Finally at about 4,000 feet, a tremendous surge of pain was followed by a loud roar—then silence. The ear drum had ruptured, due to increased outside pressure, and the resulting pain so disrupted the pilot's aim that the bomb missed the target.

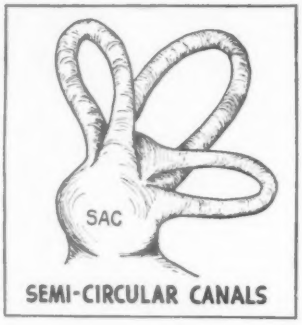



Fig. 1. The base of dizziness is in these canals.

The pilot also found that his flying and his landing sense was impaired. Later complications, followed by infection, indicated the value of the ears in balance, and later experiments along those lines have indicated that the physiology of the ear is largely responsible for some of the dizzy feelings among instrument flyers—and possibly for some of the crashes in recent years.

For example, Captain X was flying with his squadron in the dark, in clouds. For no explainable reason he took his section into a spiral, which began to get steeper and steeper. Altitude was lost, until the two wingmen found themselves at about 700 feet just emerging from the overcast, airspeed about 375, and no signs of recovery. Contrary to regulations they left the formation.

A few seconds later their leader crashed—and the cause of his death has remained unsolved except for this probability: that Captain X died because of *vertigo*. He had become dizzy due to sensory illusions of turning, which were directly attributable to the physiology of the ear.

Figure 1 shows the semi-circular canals; Figure 2 the cross-section, and Figure 3 the little hairs that cause us to think we're turning under certain conditions of "blind" or, more correctly, instrument flying. This is the most efficient sense of balance that we have, as will be explained directly.

To begin with, the term vertigo was used long before the airplane was invented. It was defined as "dizziness, or swimming of the head—a disturbance in which objects appear to move in various directions, and in which the person affected finds it difficult to maintain erect posture." Today the term vertigo applies also to what we feel occasionally during

(*Continued on page* 86)

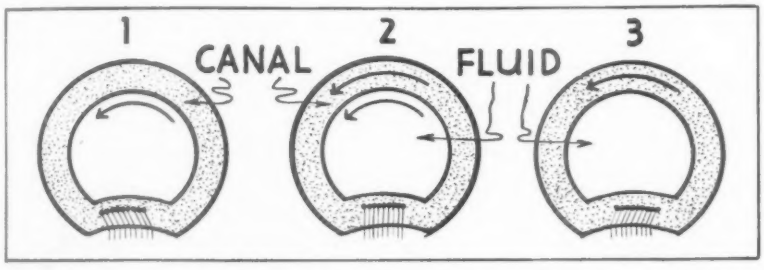



Figure 2. Unequal speed of canal and fluid movement creates false sense of direction.

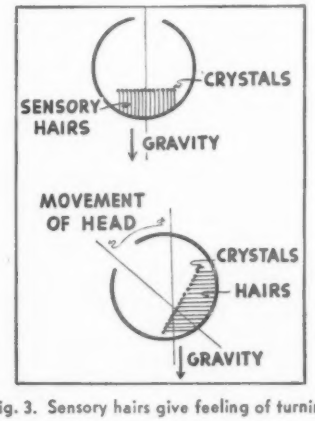



Fig. 3. Sensory hairs give feeling of turning.

Engine nacelle installation on a Vega "Ventura," developed by ground testing.

# GROUND vs. FLIGHT ENGINE TESTS

by JAMES B. KENDRICK

Chief aerodynamics and flight engineer, Vega Aircraft Corp.

*Approval of new designs has been expedited by this time-saving procedure of ground testing.*

TO DEVELOP an engine installation by flight testing methods requires more time than to determine and perfect all other characteristics of the airplane. The cost to company and customer of this elapsed time spent in testing the engine installation usually is greater than the actual cost of the flight tests, and this is especially true during the present emergency. When flight test costs, delays in production caused by unforeseen developments of the flight test program, etc., are considered, the provision of adequate facilities for conducting pre-flight tests becomes a necessity.

The Vega Aircraft Corporation has for several years recognized the value of proving engine installations by ground test methods, first to save flight test time, thus allowing more attention to be paid to strictly airplane problems and thereby expediting approval of the design project for production; second to avoid unforeseen developments of the flight test program delaying the production program; and third, to avoid service difficulties after delivery. For example, Vega designed, built, proved on the stand, and shipped to England a number of cowl assemblies for the British designed Armstrong-Whitworth *Ensign* four-engined

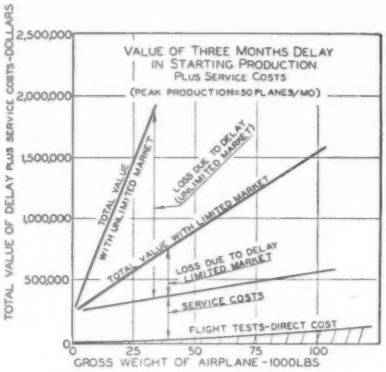


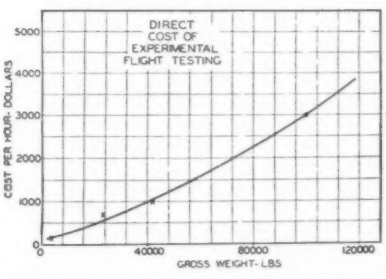

Chart portrays cost of flight testing.

transport, which upon installation proved satisfactory and are still giving good service.

One example of Vega test activity is a test stand trailer, originally built for the Unitwin power plant installation, complete with all necessary testing equipment — including torquemeter — which could be towed by truck to any desired point where the atmospheric pressure and weather conditions were suitable for test requirements.

With the experience and confidence resulting from previous activities, a complete mock-up and test stand program was planned for proving a certain engine installation in a recent Vega airplane. The test stand, constructed of large diameter steel pipe, was designed to support the engine installation in the ground or climbing altitude. Alongside, a small test house was provided with controls and instrumentation necessary for the program.

The engine installation consisted of a conventional NACA type cowl with cowl flaps at the trailing edge, a long carburetor air duct in the top with its entrance




Work done on ground cuts test expense.

at the cowl nose, an oil cooler on the bottom with entrance back near the cowl flaps, and an exhaust collector behind the engine, with a single outlet on lower outboard quadrant of the cowl.

The results indicate what may be expected from the simple test stand and is not recommended to give reliable flight test results. However, a comparison of the ground test data on this installation revealed some interesting points with regard to the engine and this method of test stand operation.

The ground cooling characteristics obtained from the test stand agreed quite well with those of the prototype airplane. "Shakedown" tests to determine the functioning of various components of the installation, such as carburetor idling adjustment, propeller stop settings, oil cooler doors, and cowl flap actuation, supercharger and propeller governor controls, agreed accurately with airplane results.

Flight cooling characteristics agreed with flight test results purely by coinci-

(*Continued on page* 110)

Stand permits "shakedown" tests of all component parts of engine installation.

# NAVY AIR TRANSPORT

by William Levenor

THE growing importance of air transport to the efficient conduct of the Navy's business is emphasized in the establishment of the Naval Air Transport Service to put transport flights on a schedule basis, and the creation of a new class of petty officers for this service.

The Naval Air Transport Service already is several months old—plans for its organization were announced in January. Its increasing value to the Navy was indicated by the recent announcement that a new division of the "specialist" rating, to be known as Specialist (V), was being set up, providing Navy billets for men experienced in air transport work.

Qualified men may enter the Navy through this new division, enlisting with petty officer or chief petty officer ratings, and drawing pay and allowances ranging from approximately $133 a month to about $199.

It presents an opportunity for important war service to men who have accumulated specialized knowledge in the operation of airports—the loading and servicing of planes, managers, dispatchers, meteorologists, traffic co-ordinators—all of the dozens of activities connected with the management and operation of a modern center of air transportation.

Air transport, of course, was no novelty in the Navy when the new service was set up early this year to provide a rapid and regular method of transporting personnel and important cargoes for its enormously stepped-up operations. For years the Navy has used transport planes to carry officers and men on official business, as well as to deliver supplies, spare parts and other urgently-needed cargo.

But the new Naval Air Transport Service was designed to make this type of operation more efficient by putting all Naval transport planes on a regular schedule.

Navy Department officials, in fact, view the air transport service as having a status which is in effect that of a part of the Fleet Train, since it provides a factor of mobility which is of particular value to the Fleet in its operations.

For instance, the speed with which entire squadrons of Naval planes can be transferred from one theater of operations to another and be ready for combat immediately depends to a very great extent on the time required to bring vital supplies up to those areas. The quickest way obviously is by air, and the Naval Air Transport Service plays a vital part in making the deliveries of supplies speedy and regular.

Operating directly under the Chief of Naval Operations (Naval Transportation Service), the new unit is organized and administered under existing Naval regulations. The original squadrons, to be expanded as the needs of the service dic-

(*Continued on page* 138)

# MANTA

by EDWARD CHURCHILL

**A projected long-range fighter, using the Davis wing is being readied for test hop.**

David R. Davis

ALTHOUGH we are building them fast and better than our enemies, there's plenty of room for improvement. We have speed, but we've achieved it by cutting down the size of our wings rather than by improving the efficiency of those wings. We have gone to greater horsepower for our speed. We have hung a lot of gadgets on our planes, put them outside where they create drag and tear down what we are trying to build up in performances.

That airplanes of today fly fast but that they land too fast is no secret. They are for concrete runways, smooth and thousands of feet long. They are not for reserve, auxiliary or hastily created wartime fields, not for treacherous night landings. But this condition may not long exist. During wartime, as in the first World War, production methods not only speed up, but design improves.

Wind tunnel tests of model indicated a top speed of 430 m.p.h. for Manta.

Our JN4D's, built by Curtiss, flew at 60-70 m.p.h., landed at 40 m.p.h. Later, designers went to 120 m.p.h. top and had a 60 m.p.h. landing speed, a ratio of two to one. That was considered pretty fine at the time. As this present war got under way, designers out-did themselves, producing aircraft which flew at 360 m.p.h., landed at 80 m.p.h., a ratio of better than four to one. That's about where the ratio now stands in our fighting planes, bombers and pursuits alike. Wing-loadings are huge and will increase. And we still require a higher top-speed, and we still have to have slower landing speed.

Where will we get it?

The revolution may be at hand. There's the Manta, to be manufactured by the Manta Aircraft Corporation of Van Nuys, incorporating the Davis wing, perfected by David R. Davis, which has proved so successful on the B-24, the huge four-engined Consolidated bomber.

The Consolidated B-24 has, at the root, the thickest wing-section used on any military aircraft being built in the United States today. The Manta, as projected by Davis and John P. Davies, president of the company, has a relatively thin wing, although it looks thick. At its root, in a 50-foot mock-up, the wing is 30 inches thick. In relation to its chord, the B-24 wing is 21 per cent thick. In relation to its chord, the Manta wing is only 16 per cent thick. Says Davis:

"The wing on the Manta (a long-range fighter) differs greatly in appearance from the wing on the B-24. However, it is basically the same wing design. The Manta is a highly tapered wing, as against a moderately tapered wing. But it is mathematically proven and it will do the job."

Davis freely discusses the Manta. His open attitude in regard to the plane he explains as follows:

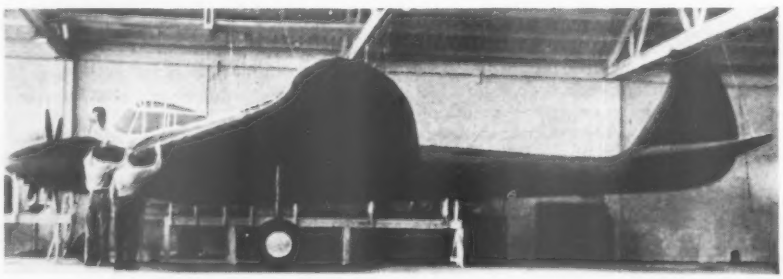
"The Manta planform has been patented. It was developed entirely with private capital, as was the Davis wing. We have no contract with the Army or the Navy, although both have been most co-operative.

"Frankly, we have been surprised by the detailed information censors have passed. But as far as we can see, there is no valid objection to printing true stories about the Manta until it becomes a definite project of the Army or Navy."

The job it will do, according to present

(*Continued on page* 100)

Mock-up of the much-discussed Manta fighter. Armed with four cannon and four .50 caliber machine guns, plane is reputed to be capable of 3,500 mile flight.



# They Keep Them *Flying*

Ground crew members are tireless in their zeal to maintain their craft in perfect flying condition.

## by ED SANDER

Maintenance Supervisor, Ryan School of Aeronautics

*Mechanical failures are rare at Army flight training schools, thanks to the maintenance men who keep the planes on the flying line.*

Ed Sander

DAWN is graying the sky over a California air field when squads of drably attired men scatter over the broad expanse of airport.

They proceed to the dozens of planes whose silver fuselages are beginning to glisten in the early morning light. From all sides they haul the graceful craft into the concentrated area of the flight line. With keen, practiced eyes they scan every detail of the plane that can be visually checked. They make sure that fuel tanks are full, and soon the still, crisp air is invaded by the sharp, cracking sound of engines warming up.

At this field and at every training base in the country, such scenes are enacted daily—long before the cadets march in from their barracks—by the men who actually "keep 'em flying," the unsung maintenance crews.

It's the first of a series of continuing operations designed by Air Forces training detachments at locations like the Ryan school, to keep a required number of planes in fit condition at all times. Faithful application to a prosaic, often monotonous routine by the nation's ground crews has reduced training mishaps caused by mechanical failure almost to zero.

When the pre-flight inspection is completed and the engines are warmed up, cadets and their instructors step confidently into their trainers, note by the mechanic's entry in the flight record permanently attached to the craft that "all's well," and the day's operations get under way, with minds clear of any worry over mechanical faults.

An Army plane is given more careful attention in its lifetime than an infant heir to the greatest fortune—and that's the reason why, for every pilot of a training plane, at least three men are needed in the ground crew while for the bomber, ten or more may be required.

Pre-flight inspection completed, the day's more laborious tasks confront the maintenance crews. There are planes undergoing the so-called 25-hour, 50-hour, 75-hour and 100-hour inspections and the daily weekly and monthly inspections—not to mention the special inspections resulting from unusual problems.

Admittedly, there is some overlapping of inspections, but with a purpose. The double and triple-checkings are designed to block the one defect which may be translated into a casualty. It's a system that private pilots might do well to imitate. Let's go out on the flight line at dawn with our maintenance crew, then follow it through a typical day's operations.

"Watch those wheel chocks and park-

(*Continued on page 74*)

Bomb trailer (left) is towed by bomb service truck. Three wheeler (foreground) is lift truck.

# Bombs Aboard

by Capt. George C. McDowell

*Leading bombs into aircraft is a tricky specialty of the ordnance man, expert in handling explosives.*

THE NEWLY enlarged municipal airport, four miles from its Atlantic seaboard town, is shrouded in darkness; not a light is visible anywhere. Amid this blackout bustling activity prevails on all sides. A laboring truck motor spurts and fades as its driver moves his heavy cargo of gasoline across the turfed terrain. A racing tug glides swiftly to the hangar for some forgotten piece of essential gear. Deep, muffled commands, floating through the blackness, help disturb the early morning stillness.

At the field's edges camouflaged bombers are being pulled from their hiding places by powerful tugs. Gasoline trucks squeak to a stop in front of each one as it reaches its appointed serving spot. Bomb service trucks, pulling loaded trailers, seek their preassigned planes to deliver their "eggs" to the plane loading crews.

One hour later all trucks and trailers leave the flying field. Crew chiefs begin warming up barking motors, while pilots and other members of the plane crews file from the hangar where their squadron commander has just finished last minute instructions concerning their early morning sortie. Soon the planes are down the newly-constructed metallic runway one by one, rising slowly with their heavy loads and immediately seeking to locate the designated rendezvous point before commencing their darkened trip to the target.

A fantastic picture? By no means. At countless small airports across the Atlantic as this is written, such scenes are being duplicated by both German and English Atlantic patrol squadrons. Naturally the time might be different; the whole operation even might be conducted in daylight at the greater risk of losing planes. London news broadcasts each evening indicate that for night bombing missions this loading must be done in the early twilight dusk if the entire trip is to be made at night.

Have you ever wondered how these loading operations—which require skill and speed in equal proportions—are coordinated? What kind of men compose these indispensable ground crews? What glory a man can hope to achieve who knows that when he delivers this bomb load there will just be another waiting for him? How they acquire that sureness of touch in handling high explosives, when one slip can spell disaster for many other men and thousands of dollars worth of valuable airplanes? All these questions can be answered in just two words: intelligence and training.

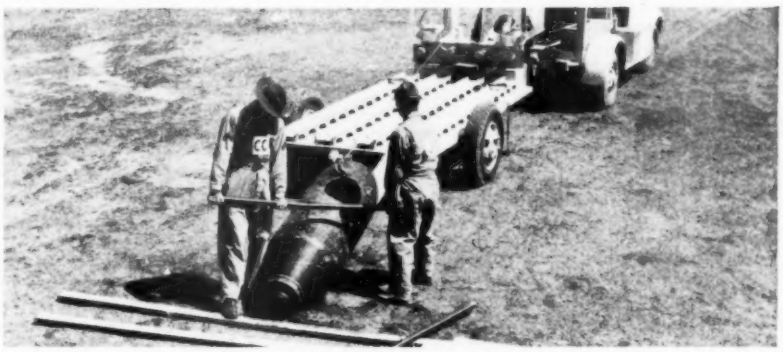
In 1938, while Germany was planning continuous bomb supply for her *Stukas*, our ordnance department was thinking

Using the bomb lift truck. A 2,000-lb. bomb is rolled into the bomb bay of a B-18A.

of similar problems. Since our ordnance department is responsible for the manufacture, storage and issue at the airplane of all Air Forces demolition bombs, many problems are involved. In 1939, a school was started at Aberdeen Proving Grounds, Md., to train officers for this new work. After three months at Aberdeen these officers were sent to Langley Field, Va., for three months' practice applying the principles learned, as the Langley Field ordnance personnel were developing new bomb handling equipment. Succeeding classes had their course shortened to two months at each place. Langley Field courses to train enlisted men in handling this equipment also were begun. This program has progressed continuously and now is being modified further to take care of the number of men needed for such work.

Recent newspaper pictures from England have shown tractors pulling four-wheeled dollies with four bombs strapped to the center pole between two axles. The actual loading into the bay of the bomber has been for the most part by hand. Our highly industrialized nation is able to produce equipment to relieve much of the back breaking work connected with handling bomb tonnage.

Our aviation ordnance companies have three main pieces of bomb handling equipment: bomb service trucks, bomb trailers and bomb lift trucks. The bomb service truck is a standard one-ton truck chassis with no cab, mounting a winch



The bomb trailer is a three-wheeled vehicle (above) with lunette attachment for towing behind the bomb service truck (below). The latter is a standard one-ton truck chassis with no cab, mounting a winch and crane extending over rear of the truck bed.

and crane that extends over the rear of the truck bed. The bomb trailer is a three-wheeled vehicle with lunette attachment for tow behind the bomb service truck. It is equipped with channel irons to provide rigid seats for each bomb on the trailer and with a chest to carry fuses; fin posts for bomb fins are mounted externally on these chests. Steel bomb cradles also are carried on the trailer to keep the bomb from resting on the ground after it is removed from the trailer and before it is loaded into the bomb bay. The bomb lift truck, for moving the finned and fused bomb under the airplane, is carried on the bomb service truck's bed. A modified form of the common garage hydraulic jacket, it has three rubber-tired wheels and a platform hydraulically operated for raising bomb and cradle.

Despite the equipment's simplicity, much training is necessary to insure smooth operations under all operating conditions. Few men enlisting in the ordnance department have had previous experience in handling explosives. However, it can be taught to any high school graduate who applies himself and has a desire to learn. The fact that any military explosive must of necessity be safe to handle under field conditions cuts accident hazards. The rough handling a bomb might receive accidentally in the field must be remembered constantly by the designer when he is drawing the plans and specifications for the manufacturer.

An aviation ordnance man must spend his first month on infantry basic training. After that period comes training in the various special fields—ammunition, welding, automobile mechanics or any of the other specialties to be found in an aviation ordnance company. Quite naturally, not all men have to be munitions experts; there are just as many specialists ratings in other sections of the company. But the ammunition section is the one with the responsibility for delivering all bombs and machine gun ammunition to the airplanes. Obviously, bombs are the most difficult to handle because of their increased weight. Besides the inherent poundage, the explosive factor must be reckoned with in all handling operations. Team-work consequently must be developed and kept alive by constant drill for all ammunition section men.

The ammunition section basic training and operating unit in an aviation ordnance company is the bomb service crew, consisting of five men: a crew chief and four munitions workers. Experience has proved that this is the minimum number of men that can prepare a bomber's load, no matter whether the ship is a light, medium or heavy bomber. Since the plane crew must load the bombs one at a time into the plane, these men can deliver finned and fused bombs at the plane as fast as the plane crews can load them. With the new type fuses it no longer is necessary to fuse all bombs as a safety precaution before they are brought to the plane, as was the case not many years back. This new method also permits increased speed (with

(*Continued on page* 143)

# Ontario's Forestry Flyers

by WILLIAM A. BAKER, Jr.

*The world's largest force of fire flyers patrols 120,000,000 acres of heavily wooded forest land.*

FORCED down in dense forest north of Lake Superior, a pilot lay unconscious in the wreckage of his plane for a day and a half until a hard rain brought him to. Weak from a cut on the head and crippled by a broken wrist and a broken hip, he was unable to get a fire to burn in the sodden wilderness until four days after the crack-up. Then, as the lost aviator was thawing himself out and drying his clothes, searchers who had flown several times over the spot saw a thread of smoke and, looking back, detected a bright red speck on the ground. Ever since that rescue, red blankets have been standard equipment of the Provincial Air Service of the Ontario, Canada, Department of Lands and Forests. All the planes are painted yellow so that they can be seen in the green woods.

G. E. Ponsford, Forestry Air Service Director, and his Stinson "Reliant."

In spite of hazards such as smoke haze, electrical storm, fog and doubtful landing surfaces, accidents are rare, Ontario officials state, in the three-quarters of a million miles of flying logged every year by the Provincial Air Service, which is said to be the largest air force in the world engaged in fire protection. It recently completed its 18th season over an expanse of bush so vast that the entire state of Texas could be dropped into it. Ontario has 120,000,000 acres of forest land under organized protection. Of the Province's $691,250,000 estimated potential revenue resources, $578,250,000, or 84 per cent, represents the value of forests.

From the PAS headquarters at Sault Ste. Marie, G. E. Ponsford directs the work of some 85 men, including 26 aviators. The 26 PAS planes range from small *Moths*, used solely for detecting fires, to transports which carry payloads up to 2,000 pounds. The Service's investment in equipment, including aircraft and improvements, is approximately $3,000,000.

In the wilderness north and east of Lake Superior, where the PAS does most or its flying, there are few landing fields but thousands of lakes and streams; consequently, the planes are equipped not with wheels but with pontoons. At the operations base the planes take off from the St. Mary's river, just below the Soo locks.

It is the responsibility of the Air Service to provide planes and trained personnel which, when allocated, come under the general forestry ground service.

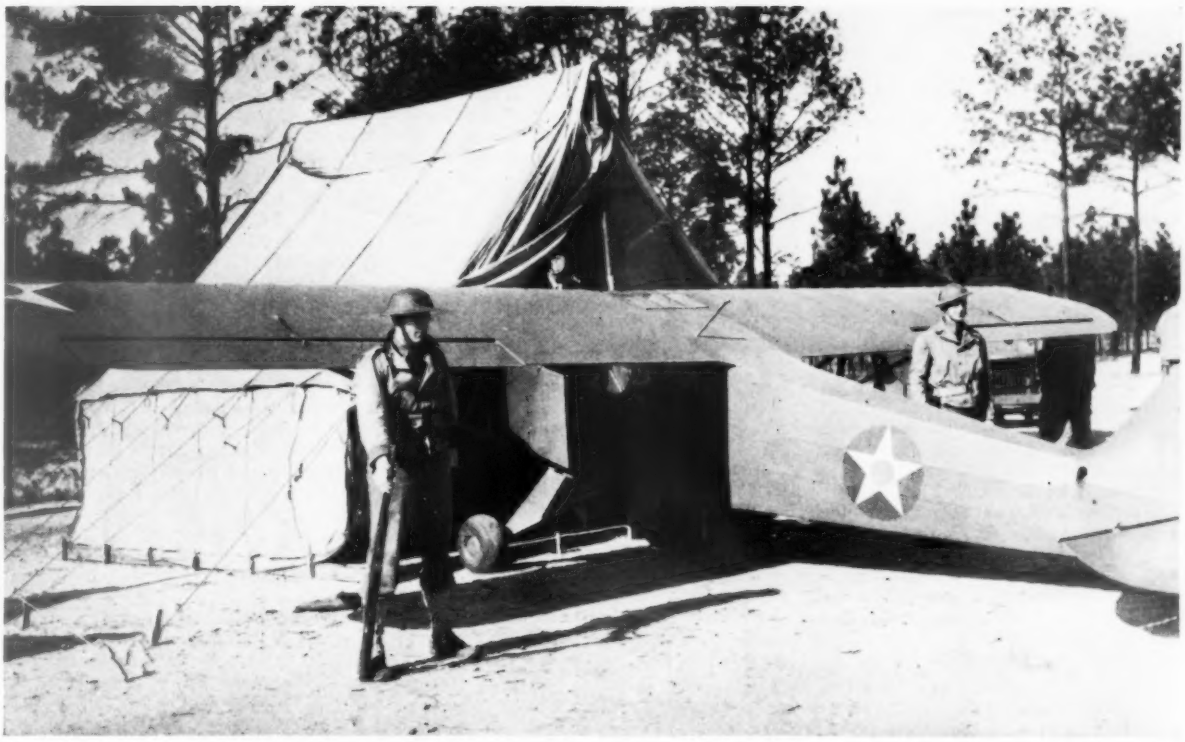
The province is divided, a little east of Lake Nipigon, into two administrative districts, with western headquarters at Sioux Lookout. It is divided, also, into forestry districts, each under a district forester who organizes his district to meet his requirements.

The need for aircraft detection is gradually disappearing, officials say, with the increase of towers annually, although all towers still have to be serviced by aircraft for food and for repairs to radio equipment. Ontario is fairly well towered from its eastern section to Lake Nipigon and Port Arthur and much of this area can be observed from towers connected by radio with deputy headquarters of the department. The entire organization within a district is linked up by radio or telephone. Five of the aircraft are equipped with two-way voice-to-voice radio, and a district forester can sit in his office and talk with an airplane in flight by merely having the operator connect him with the "air channel," which is his radio system.

When a towerman observes smoke he reports it at a certain number of degrees from his tower as he would read it on a compass. If two towers detect smoke and are uncertain what it is, they ask a plane to go out and report to them. Aircraft are allotted to districts with consideration of normal fire hazard and facilities within that district for fighting fires, such as roads, railroads and water routes.

Immediately a fire is found, the deputy in the district decides upon the most economical transport, which may be railroad speeder, boat, truck or airplane. If a plane is used, two men, a pump and some hose are carried.

(*Continued on page* 103)



Nose of Piper "Cub" L-4 liaison plane is protected by tent against blowing sand. Projecting tube guides radio antenna.

# The Lightplane Joins the Army

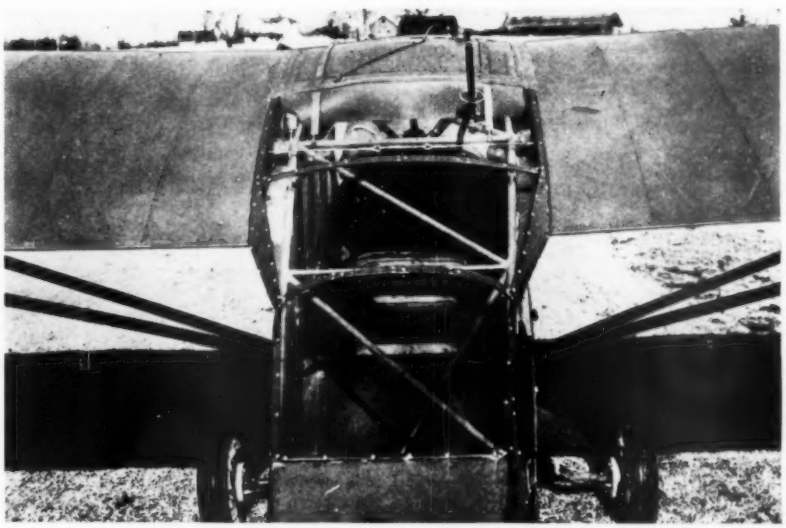
by ALFRED TOOMBS

*Sky flivvers may become the aerial jeeps of the Army. They now are being used by the artillery.*

THE lightplane has officially gone to war. The output of America's 53 manufacturers of the small ships was assigned by the War Production Board exclusively for the use of those engaged directly in the war effort. Thus, thousands of these sky flivvers follow into the country's service the sportsmen pilots who have proved them out through the years.

This means that private flying is being kept alive in America—the only belligerent nation where this is true. The United States, often so profligate with its resources and talent, this time is finding real work for both. The War Production Board decision is in keeping with the official Washington policy to keep civilian flyers and their ships in the war effort—not out of it.

The WPB order directed that after February 17, manufacturers must deliver all new planes with less than 500 h.p. only for use by the Government, by our Allies or by civilian organizations engaged directly in war work. This order had the effect of formalizing what had been a standing policy since our entry in the war and made official the status of the lightplane as a vital tool of defense.



Observer can face forward or back in this L-3, developed by Aeronca for the Army.

The manufacture of light aircraft, of course, requires the utilization of large quantities of critical materials, which must be used with caution because of the demand for these same items in the war industries, the essential civilian industries and for export. For some time, the lightplane industry, because of priorities, has been able to obtain just enough material to keep up with war related work. Lest there be any charges of "business as usual" or any possibility of the diversion of any lightplanes to civilian use, the WPB issued Order L-48 prescribing in exact terms the place which the industry is to occupy in the war effort.

The order first defined "light aircraft" as any plane with an engine or engines of less than 500 h.p. in the aggregate and said that such planes should be considered "new"—and therefore subject to the terms of the order—if they had been manufactured since October 1, 1941, and had been flown less than 100 hours.

In setting forth what must not be done with such new lightplanes, the order said that "no persons shall sell, lease, trade, lend, deliver, ship or otherwise transfer any new light aircraft and no person shall accept any such sale, lease, trade, loan, delivery, shipment, or transfer . . ." for any purpose except those specified.

First on the preference list are the Army and Navy, the Maritime Commission, the Panama Canal, the Coast and Geodetic Survey, the Coast Guard, the Civil Aeronautics Authority, the National Advisory Committee for Aeronautics, and the Office of Scientific Research and Development. Lightplane deliveries will also be made to the governments of the United Kingdom, Canada and the other Dominions, Crown Colonies and protectorates of the British Empire, Belgium, China, Greece, the Netherlands, Norway, Poland, Russia and Yugoslavia. Agencies of the United States Government are entitled to deliveries of lightplanes for transfer to other nations of this hemisphere or elsewhere under terms of the Lend-Lease Act.

Private individuals engaged in war work will get preference in obtaining planes. The order provides that deliveries may be made to persons specified on any delivery schedule which has been approved by the Joint Aircraft Committee. Likewise, members of the Civil Air Patrol, operators of any Civilian Pilot Training Program and any State Guard Unit organized under provisions of Army Regulations, are eligible to purchase new lightplanes.

CAP members, CPTP operators and state guard units, in order to obtain planes, must execute on the purchase order, the bill of sale or contract for the plane, a brief form specifying that the ship is being purchased for defense work. The following is the text of the statement which is required:

"The undersigned hereby certifies to the War Production Board, pursuant to Limitation Order No. L-48, that the undersigned is (Specify whether member of CAP, CPTP operator, or State Guard Unit) ..... and that the light aircraft described in this instrument is purchased solely for use in connection with such activity; and the undersigned agrees to retain said aircraft until not less than 300 hours of use in connection with such activity have been certified in its logbook."

This form must be signed by the purchaser, as well as the duly authorized officer supervising the activity for which the plane is being bought. The execution of this form is absolutely necessary as proof that the purchase was made in accordance with the WPB order. It is protection for the seller and the latter may make a sale in complete good faith upon the execution of the form.

It will be noted that there are a number of other persons who might expect to purchase lightplanes for defense work and who are not mentioned in the WPB order. These would include such persons as those operating CAA approved pilot training schools not in the CTPT. There is a provision in the order permitting them to buy planes. This provision states that any purchaser who can establish the claim that a plane is needed for an essential war purpose may obtain a certificate from the Director of Industry Operations, approving the transfer. When the prospective purchaser files such a certificate with the seller, the deal can be made in conformance with the WPB order.

When the operator of a CAA approved pilot training school or other person entitled to consideration under this provision wishes to obtain WPB approval for a purchase, he should send in Form 285. School operators are advised to send their application forms to Maj. John Morris, Director of Civilian Pilot Training at the CAA, with the request that he endorse it and send it on to WPB. Others should send their applications to the Aircraft Branch of the WPB. It is believed that in cases where it can be shown the plane is actually to be used for war related activity there will be little delay in obtaining the certificate.

The order does not prohibit transfer of title to a plane under terms of a contract issued prior to the date of issue of the WPB order, nor does it prevent the repossession of a lightplane upon default of a contract entered into before the date of the order.

These provisions of the L-48 order put the lightplane industry on an all-out war basis. The order will end the possibility of anyone obtaining a new plane for pleasure purposes, but will assure that the full facilities of the manufacturers are devoted to producing ships for defense.

The ability of lightplanes to operate from roads, fields and lots was an important factor in their adoption by the Army.

Beyond this, the L-48 order restricts the amount of aluminum to be used in the manufacture of lightplanes. This order will not bring about any major change in the structure of lightplanes, since all of the manufacturers have long since re-designed their ships so as to hold to a minimum the amount of this critical metal consumed. The order limiting use of aluminum was in two parts, one taking effect immediately and the other directing further curtailment by September 1 last.

The limitation which took effect immediately provided that no one shall "commence to manufacture any light aircraft which has aluminum ribs and which contains in its airframe any quantity of aluminum in excess of 12 per cent of the weight of such airframe."

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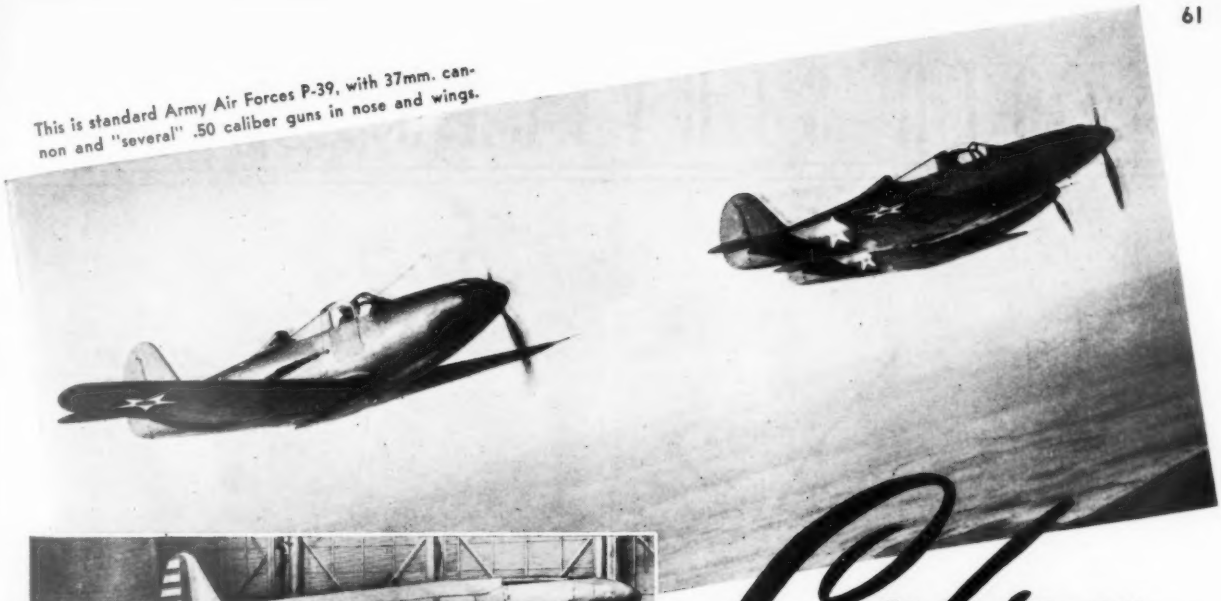
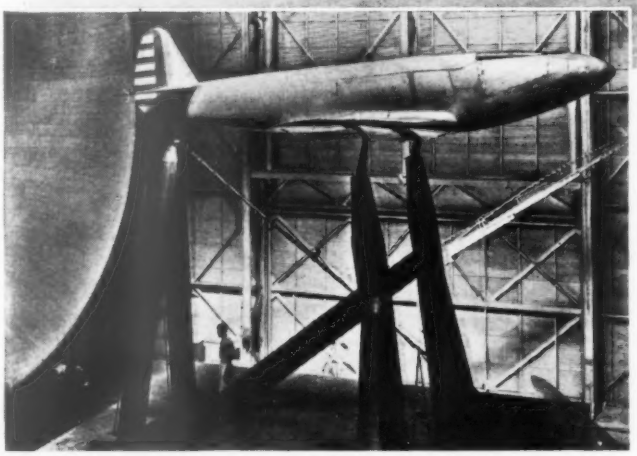


This is standard Army Air Forces P-39, with 37mm. cannon and "several" .50 caliber guns in nose and wings.

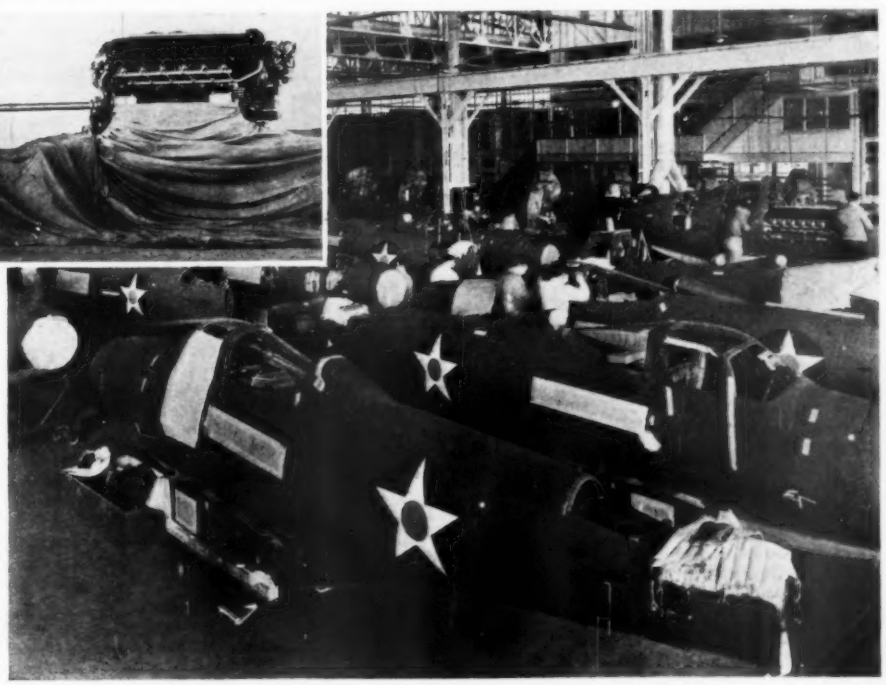
# Cobra

WHATEVER you may have heard among local gossips, one thing should be remembered about the Bell *Airacobra:* it is one of the world's best fighters *in the category for which it was designed.* As it has to the P-40, criticism has come to the Bell—almost all of it unjustified. The most radical fighter in the U. S. when it first appeared, the *Airacobra* (P-39) was the first tricycle-geared fighter, still has the only engine-propeller drive shaft. It was the first modern fighter to use the 37 mm. cannon; a model for the RAF (many subsequently taken over by the U. S.) mounted the 20 mm. cannon. The *Airacobra* went into production in 1939 and now is being produced in large numbers by several Bell factories and subsidiaries.



Stripped of all protruding parts, the first Airacobra was tested in NACA wind tunnel at Langley Field. Tail surfaces later were changed.

Bell's drive shaft was one of the most radical aeronautical developments in recent years—and one of the most successful. Cannon barrel extends through whole nose section.



These are "Airacobra" fuselage entering final assembly at the main Bell factory at Buffalo. The P-39 is 29 ft. 9 in. long; wing span is 34 ft. Heavy armor and bulletproof glass are used.

# ✪ AIR SERVICES *Section*

Cadets demonstrate actual buoyancy of a two-man rubber raft.

Emerging from pool after learning to swim when fully clothed.

## NAVY TEACHES ITS PILOTS TO SWIM

ON a hot strip of sandy soil bordering the Gulf of Mexico future Navy air fighters are learning how to save themselves from drowning in the Java Sea, the English Channel, the Pacific Ocean, the Bering Straits or in whatever body of water they might involuntarily find themselves.

The locale is the U. S. Naval Air Station, Corpus Christi, Tex., and the subjects are a variety of Navy personnel including officers, cadets and enlisted men. The teachers are physical training officers, all of them familiar figures in civilian life athletics.

In reports which have come home from all fighting fronts since the war began, it has been entirely too evident that there has been needless loss of fighting men because of drowning. Airplane pilots, soldiers in transports and even seafaring men have lost their lives simply because they either could not swim or could not swim well enough.

The Navy is determined that it will do all humanly possible to insure its men against death which is caused by remediable physical deficiencies. A vital part of this physical building up program is swimming.

At the "University of the Air," as the Corpus Christi air station is popularly known, much emphasis is placed on swimming as planes in this war, whether of the land or sea type, spend a great deal of time over bodies of water. As the fortunes of war direct, they may be shot down over the water or forced down because of accidents, engine failure or combat damage.

Whether the pilot has a rubber life raft aboard or not he still stands a good chance of drowning after his plane smacks into the water. He has to inflate the raft and climb onto it, and then in a high sea he may find himself from time to time thrown out and faced with the problem of struggling back to it. And all too often he is projected right into the water, minus plane and raft, supported only by his own lifejacket (his "Mae West") and his ability to swim.

And there is the additional hazard of fire. Fire may spread out over the water either from a burning plane or ship. Strange as it may sound to some, the presence of fire over the water by no means presupposes sudden and certain death—but it does to the uninitiated.

The swimming coaches at the "university" are also demonstrating how to swim in oily and burning waters as an integral part of the swimming program. The trick here is to submerge for the majority of the time, and to beat the flames back with your hands as you break water in coming up for air.

In fact, submerging and slow swimming is the basis of the swimming instruction. Nothing fancy is taught, speed is forgotten. The Navy wants its pilots and other flying personnel to compare to contest swimmers as a "mudder" would to a fast race track horse: in other words, slow and steady and able to swim under the most adverse conditions.

All day long at the main station of the great Navy training center and at the outlying fields, officers, cadets and enlisted men are lining up along the pools, learning how to stay afloat, stay submerged, how to swim with clothes on, how to undress in the water.

What is desired is simply strong lungs, powerful arms and legs and an increasingly strong will to save one's self.

The majority of all service men know *how* to swim, but only the minority how to swim *well*. Many of the aviation cadets who report for their swim tests felt until then that they could swim better than average. Many of them have found to their profound surprise, however, that they could not stay under water more than a few seconds before coming up gasping and sputtering.

The type of swimmer the Navy wants all of its sons to be is indeed better than average. According to the swimming instructors, a man who can swim half a mile without pausing is a "good" swimmer, but not exceptional.

And in like manner a man who can make some flashy speed with the crawl stroke is by no means singled out for the top of his class at this air station. The breast stroke or the side stroke are considered the best utility and distance strokes for Navy purposes. It has been found that it is almost impossible to use the crawl to advantage when clothed.

Two of the guiding lights in the swim program at Corpus Christi are Lieut. (jg) Gordon H. Chalmers (on the American Olympic Swimming Team in 1932), and Ens. John W. Dowdle, Jr., west coast swimming instructor.

These men have gone through everything that can be gone through in the water to demonstrate to their pupils how to save lives when someday their worst expectations may be realized. They have dived through fire and slopped around the pools in full clothing—by evening lesser persons than these two would be thoroughly waterlogged.

They and their assistants are impelled, however, by a constant and harrowing thought—letting up for a few moments,

qualifying one cadet as a swimmer who in reality is only half a swimmer may one day cost that man his life.

It is that "one day," so apt to arrive for so many persons in war time, that not only the swimming experts but the whole of the physical training staff at Corpus Christi and other training centers are trying to plan for—so that pilot John Smith when he is forced down will have a better than even chance of surviving.

So that he, moreover, will be able to come back again in a few days, or maybe a few weeks, and have another shot at the Axis.

* * *

## Cadet Knucklehead

THE epitome of stupidity, that's Aviation Cadet Knucklehead of the Army Air Forces. The little gent, noted for his deficiency in grey matter, will be starred

The Air Forces' "epitome of stupidity."

in a forthcoming series of instructional films prepared at Randolph Field, Tex., for circulation to Air Forces' schools throughout the country. Cadet Knucklehead will commit more errors than a bush league third-baseman, and other aviatic cadets are expected to profit by his mistakes. If Knucklehead weren't so dumb he couldn't hold his job.

A series of specially prepared drawings of Cadet Knucklehead in action will be presented in this section monthly.

* * *

## Skilled Men Needed

THE Army needs 100,000 skilled mechanics and technicians. Many of these, including men capable of serving after only the briefest training as radio operators and mechanics, aircraft armorers, mechanics, welders, and metal-workers, are wanted by the Air Forces.

Recruiting stations are waiting to tell the Army's story to the skilled men who are needed immediately. Army training schools are turning out thousands of men trained along these lines, but will scarcely keep pace with immediate needs until late in the year. In the meantime thousands of men already experienced are needed.

They will be enlisted as privates, drawing $50 a month, but their chances of getting ratings at double that pay or better should be good, as non-commissioned or technical ratings are often given men doing this kind of work in the Air Forces.

Applicants must be cleared through their local Selective Service boards, to avoid stripping vital war industries of needed men. Air Forces applicants must pass a special intelligence test as well as an oral trade test and the regular physical examination. Those accepted will be sent to a Reception Center and thence to an Air Forces station. The emergency thus offers a rare opportunity for trained men to fight with the tools with which they are accustomed to work.

* * *

## A "First" for Chanute Field

CHANUTE FIELD, Ill., AAF Technical Training Command, claims the honor of having produced the first AAF pilot to shoot down a German plane. He is 2nd Lieut. Samuel F. Junkin, Jr., a former Chanute Field airplane mechanic, who is credited with having shot down one of the Nazi's newest fighter planes, a Focke-Wulf, during the Commando raid operations on Dieppe late in August.

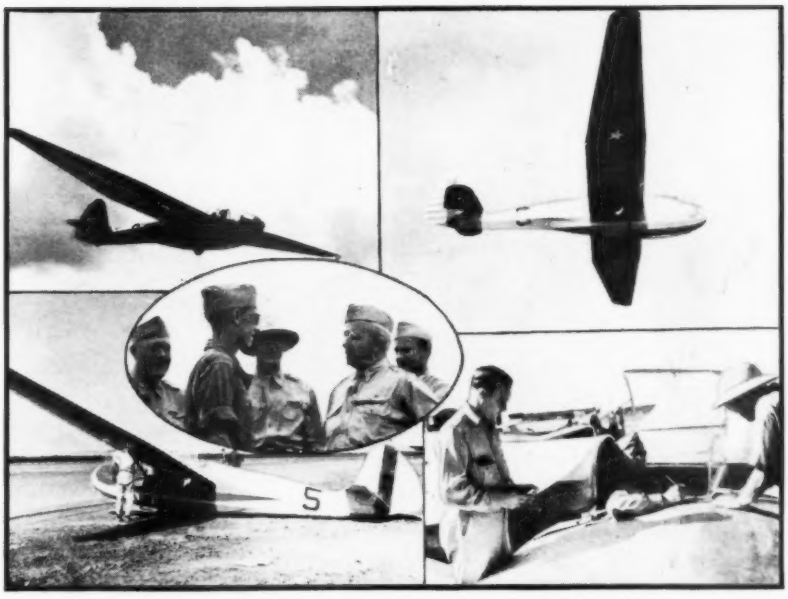
After Lieutenant Junkin had scored his success, he was forced to bail out of his plane with a bullet through his right shoulder. He was rescued from the Channel by a Commando barge, and soon was recuperating in a British hospital.

It is particularly interesting to note that Lieutenant Junkin was originally rejected for Army flight training because of insufficient college credits. He then took the airplane mechanic course at Chanute Field, and his success in this work led to his later acceptance for flight training.

* * *

## Redesign Paratroopers' Uniforms

UNIFORMS of the Army's paratroopers have been redesigned so as to provide more freedom of action, as well as additional space for carrying equipment. The two upper breast pockets have been slanted to afford easier access and permit the paratrooper to grasp needed equipment while riding the 'chute down to the ground. The back of the coat has been restyled with an additional flare added by cutting a seam across at the waistline, thereby affording more freedom of action when landing or running.



Glider piloting is fast becoming an important AAF branch.

## THE ARMY'S NEW AIR ARM

DOWN near the Delta country Uncle Sam is rapidly building up a new air arm—glider pilots for the Army Air Forces. The above views at a southeast training center school show two of the small two-place gliders soaring gracefully (and silently!) after having been released by their tow plane. Inset shows Maj. Gen. Barton K. Yount, commanding general of the AAF Flying Training Command, conversing with a student during a recent inspection tour of the new base. In back row are, left to right, Maj. Robert Trumbull, M.C., assistant staff surgeon, FTC; Capt. Carl Luetcke, Jr., A.C., commanding officer at the post, and Lieut. Col. Henry T. Morrison, A.C., of the personnel division, FTC. At lower right, General Yount takes notes after a flight. Many such glider schools now dot the country as the Army turns this former sport into a potent arm of war.

Taken over by the Army as an experimental bomber, the "Owl" proved capable of flying with one of its three engines dead.

# 'Plastic' Planes Are Not New

by RAOUL J. HOFFMAN

*As chief engineer of the company that manufactured the airplane described here, the author was largely responsible for this highly significant development of 24 years ago. The "Owl" was an unusual advance.*

LATELY we read much about strides made in the development of plastic airplanes—airplanes that are made of wood laminations bonded by resinous cement, shaped about a mold, pressure applied and slightly heated until the cement is set. These airplanes could be manufactured economically only by quantity production, for the cost of the mold would be nearly even to that of the whole airplane itself.

Wood structures, especially plywood designs, were discontinued years ago due to the deterioration of animal glue, regardless of the fact that plywood constructions have a higher strength-weight ratio than those of steel or aluminum alloys. There are, however, a few new metal alloys that give higher ratios than plywood. Against fatigue, wood will always be in first place. Even the so-called waterproof (casein) glue did not popularize the use of wood, for this kind of glue can not be brushed on and a very heavy pressure is required to make a perfect glue joint.

Years ago, however, laminated wood fuselages (monocoque) were used in many countries. Laminated fuselages were introduced in this country in 1915 by the L.W.F. Engineering Co., College Point, N. Y. That company manufactured, during the World War, numerous airplanes having "plastic" fuselages. It is also a fact that the famous Liberty engine had its first flight in a plywood fuselage of the L.W.F. company.

L.W.F. employed by 1918 about 1,400 men and 800 women workers. It manufactured HS-2L flying boats for the coast patrol work and numerous training ships.

Following the war, the company converted its facilities to commercial aviation. It converted many DH-4s to fly the mail between New York and Washington, D. C. It also built a few J-1 planes; this was another DH-4 conversion using two Hisso engines.

L.W.F. also built a 10-ton plane with plywood fuselages. It was to carry 2,000 pounds of mail between New York and Chicago on an overnight, nonstop service. Because of this service it was named the *Owl*. It was conspicuous for its huge size, which was not surpassed until a few years ago. The illustrations accompanying this article show interesting details of its construction.

The *Owl* was a biplane with a wing span of 105 feet and a wing chord of 11 feet. It had two fuselages and one nacelle made of plywood. Three Liberty engines gave it a top speed of 105 m.p.h. It carried fuel for 7½ hours flying at top speed, or for 10 hours flying at cruising speed.

The preliminary design started in November, 1918. It was to use two Liberty engines and to have a total weight of 14,000 pounds. After further consideration of distance and payload it was increased to three Liberty engines and to 20,000 pounds total weight. Two engines were to be tractors and the center a pusher. The center body was to be a cabin, with sleeper accommodations and mail chutes for dropping mail at intermediate cities without stop.

First, patent infringements made it necessary to make a tractor out of the pusher engine. Then again the cabin was replaced by a nacelle in order to increase the speed. The construction of the *Owl* started in 1919.

Most interesting was the construction of the fuselages and nacelle; they were made over a mold. The mold was so constructed that by removing two small center pieces the two remaining larger units could be easily taken out through the frontal opening left for the engine mounting.

The heavily waxed mold was covered

with wax paper and then wrapped with muslin. Then the first layer of $\frac{3}{32} \times 1\frac{1}{2}$ spruce sheathing glued spirally at a 45° angle to the form. The necessary pressure was applied by self-locking straps. After the glue was set, the form was wrapped again with muslin and the second layer of spruce glued spirally in opposite direction to the first layer. These two layers would conform to the well-known geodetic construction. Another muslin wrapping added and the third layer of birch for the first half of the mold and spruce for the remaining portion was glued parallel to the axis of the fuselage. After sanding the outside surface, a muslin covering finished the job. The mold was then removed, the inside finished and a six-inch plywood reinforcing placed where the main bulkheads were located. Four longerons were added to take the stresses of the cutouts. No longerons or bulkheads were used for the rear 20 feet of the fuselage.

Animal (hide) glue was used. It was heated to 150° and the glue room kept at 100° to prevent an early chilling of the glue.

On its first flight the plane took off in such a short run that even the pilot was surprised. This was not only due to the streamlined fuselages, but also to the thin cambered wing section which no designer previously dared use.

In order to increase the gliding angle of the machine, the propellers were made free-wheeling by a compression release of the engines. They were removed, however, for it was supposed that revolving propellers give higher resistance than blocked ones. It also should be mentioned that the now-famous Arens engine controls first were installed on the *Owl;* Charles Arens was an experimental engineer with the L.W.F. company.

Surface radiators designed for the Liberty engines could not be manufactured, owing to the lack of facilities. They were replaced by regular honeycomb, fully-exposed, radiators that reduced the top speed from the estimated 112 m.p.h. to 105 m.p.h.

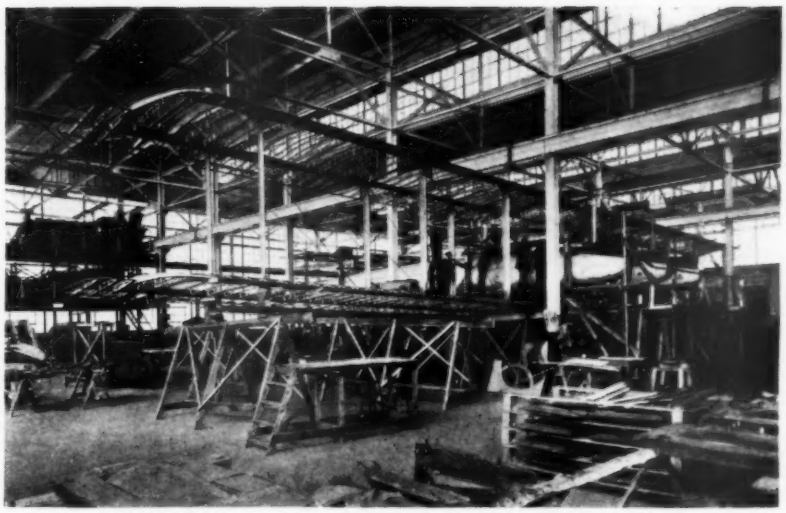
Every part that went into the machine was tested. Ribs were subjected to loads for low speed. Some units were reduced in size to fit between the grips of the testing machine in order to obtain the coefficient for calculating the full-size unit. Traction resistance on tires gave the constants for estimating landing gear stresses. All fittings were made of heat-treated .40 per cent carbon steel.

The time of oscillation about its three axes was estimated. Also its maneuverability was calculated. And it was estimated that the *Owl* could fly with one outer motor dead. This information was supplied to the test pilot so that he would know what to expect from a machine of a size he never flew before.

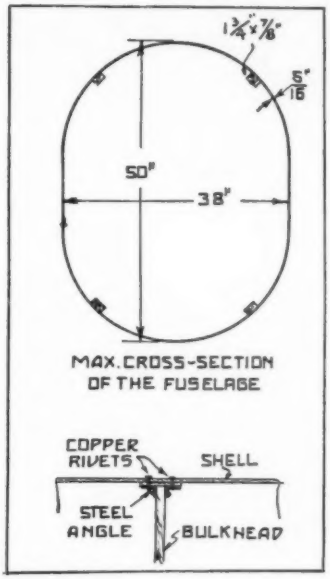
Because of lack of emergency landing fields between New York and Chicago, the *Owl* was later taken over by the Army to be used as a bomber.

The new trend in plastic planes soon may start many old timers where they left off many years ago.

END



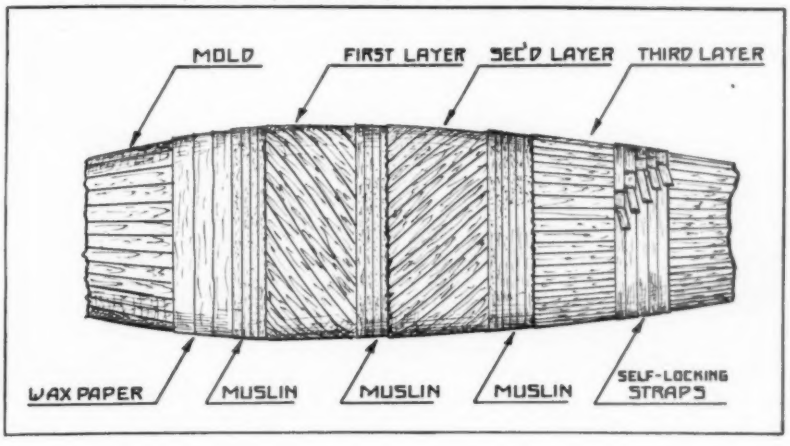
This is the "Owl" under construction at the L.W.F. plant on Long Island.




Some fuselage construction details.

Inside the mold for the fuselages.

This first "plastic" airplane used a great deal of muslin in its fabrication.

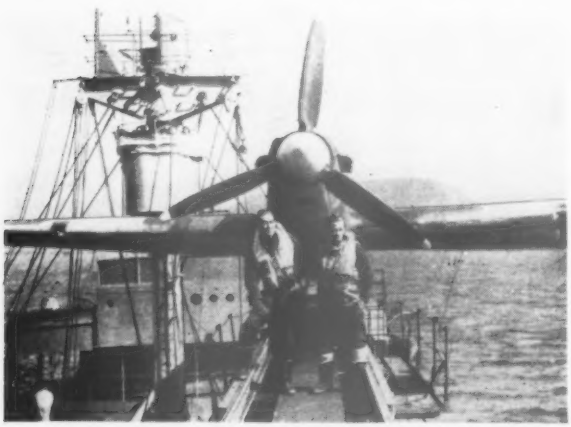


Now in service on Lake Michigan as a training carrier, The U.S.S. Wolverine is a former Great Lakes excursion steamer.

# HAVE YOU SEEN?

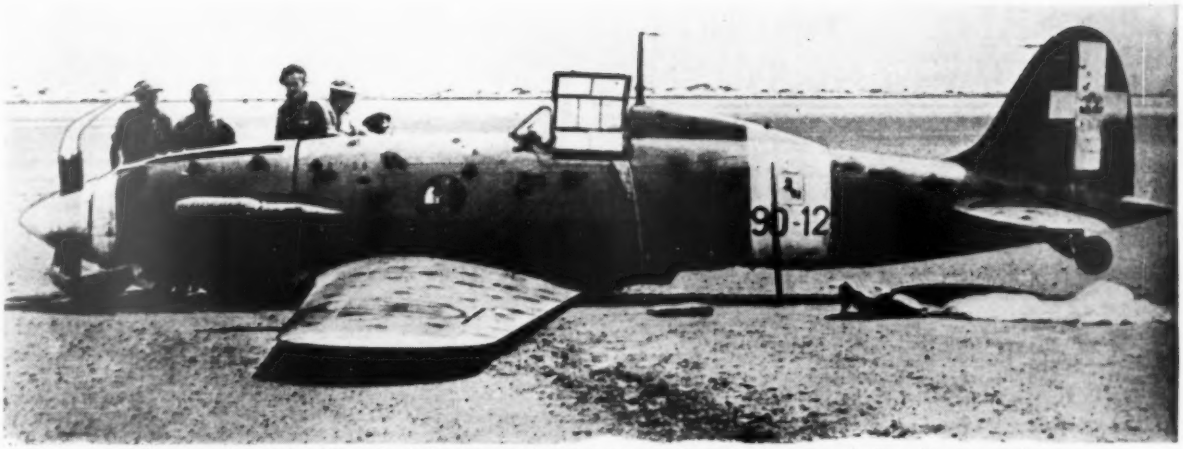
This is one of the few snowplows that ever went to sea. It is clearing the flight deck of a U. S. carrier after a storm.

North American "Mustangs" now are in service with the RAF. Note tunnel opening behind cockpit, probably for a camera.



First picture of an RAF catapult "Hurricane" received in the U. S. Plane is on merchant ship, fights off Nazi Focke-Wulfs.

Army's new plywood trainer is Ryan PT-25. Only two per cent strategic materials are used. Engine is 185 h.p. Lycoming.



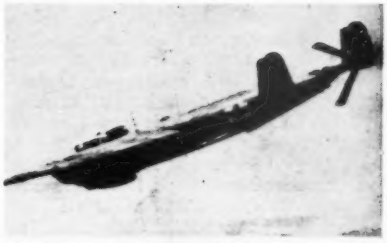
Shot down by RAF in Libya, this Italian Macchi C-202 fighter was found to be powered with a German engine.

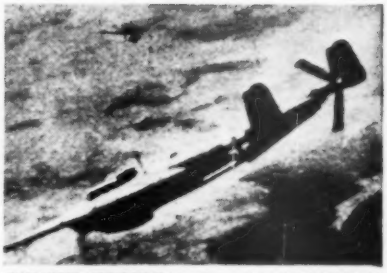
Standard equipment on Martin B-26's is torpedo rack, shown here carrying a bomb.

Following American practice, the RAF now trains some pilots on U. S. lightplanes.

Now used by Spanish air force, this Vultee V-1A formerly was an airliner in the U. S.

First foreign warplane to carry U. S. insignia is this "Spitfire" of Army in England.





Germany's newest Dornier Do-217 dive bomber has unusual dive brake in tail, shown in operation (above) for first time.

# I LEARNED ABOUT FLYING FROM THAT!—NO. 40

by ALMA HEFLIN McCORMICK

*A dropping barometer, snow flurries and a range of mountains below added up to "trouble aloft."*

IT is amazing how much meteorology you can learn from books, even the answers to terrific questions like what the weather would be southeast of the Great Lakes if a polar air mass crossed them after originating in Alaska, if you struggle long enough.

It is the application that takes time to learn, time in the air, and sometimes time on the ground while it soaks in. For instance, there is the axiom that as the barometer falls, the altimeter reads higher. It cost me several bad hours and a scramble down a mountain to learn that one. I learned it over the stretch known as the "pilots' graveyard." I won't forget it.

I had been on an aircraft sales promotion trip down in the Carolinas, and it had become rather on the killing side before it was finished. There was an average of four or five hours sleep a night for two weeks. Nothing looked so good as home. Probably that is why I barged ahead when the weather soured.

I was flying a sort of loop that swung to touch the seaboard and then westward to home. The first part carried me over toward the Shenandoah Valley, and at one field after another, when landing was necessary to refuel, the wind velocities read higher; and ahead Harrisburg sounded definitely suicidal. Obviously, something was brewing on the weather map, but perhaps things would change during the swing toward the coast.

On the coast, the radio reports showed less wind, but the barometer was still dropping. Light snow flurries were reported here and there in the mountains, but light snow flurries are more or less routine there, so I took off once more.

The "light snow flurries" were a good deal heavier than that. I hit the first of them past the first high ridge of the mountains and for a frightening minute it masked the windshield like a blanket. Then it cleared. I glanced at the mountains below. According to my map, this mountain was about 1,000 feet high. As long as I cleared it by 1,000 feet, all right, but the route showed mountains of increasing altitude, so I noted their height and started a gentle, steady climb.

It was during the third flurry that I definitely realized that I should have turned back. But breaking out past Shenandoah I had only a brief stretch, comparatively speaking, before we should come out over the Susquehanna River near Bloomsburg, and from there we could follow the river home. I looked back and made mental note of a pasture near town. If necessary, I could turn back and land there.

There was no chance to turn back when the blizzard hit. Before, the snow had come briefly. And always by looking down I could see, if dimly, the contour of the mountains. This time it was a smothering cumulus cloud. Wetly clinging, it packed the windshield. Vision ahead was blocked in seconds. Through opened side windows, the mountains below were only a dim dark floor, level now—but if the ship were climbing, an upsloping mountainside might look level until the moment we stalled and spun,

Her hour over "pilot's graveyard" taught the author a healthy respect for caution.

or if it were downsloping, we might be in a dive that would end in tangled wreckage on the floor of the valley.

I drew a shuddering breath, and looked at the instrument panel. There isn't much on a lightplane panel. But if the tachometer raced, the ship was diving. If it slowed, we were in a climb. There was always a lag, but what else could I judge by? I looked prayerfully at the tach. The compass, too. It would lead me on to Bloomsburg—if I didn't hit a mountain first. I snatched a quick glance at the altimeter—surely five hundred feet margin. I didn't dare start a climb without a horizon. No, it would have to be this margin reverently and carefully cherished above the altitude indicated on the map.

For a frozen moment I remembered that the notations on the map told the altitude at the contour line. It might read 2,000 feet, for example, and actually be 2,495 feet. It would not read 2,500 feet until it actually reached that altitude. The contour line here was the top of the mountain according to the map, but I let out my breath in a strangled shiver.

That is, perhaps, why the next moment was such a shock. I was glancing past the smothered wing-tip when the beacon-tower flashed by. For a split second it didn't register. A beacon tower? Five hundred feet above the mountain? And then it did. *A beacon tower!* And it was *inches* from my wingtip.

There wasn't any use of climbing. Climb, with no horizon, and I would probably spin in. I looked at the tachometer, and at a cheap ball-bank indicator centered on the panel. I looked at the dollar watch on the cowl, with its minute hand measuring off perhaps the rest of my life. I started, as nearly as you can without instruments, a standard turn.

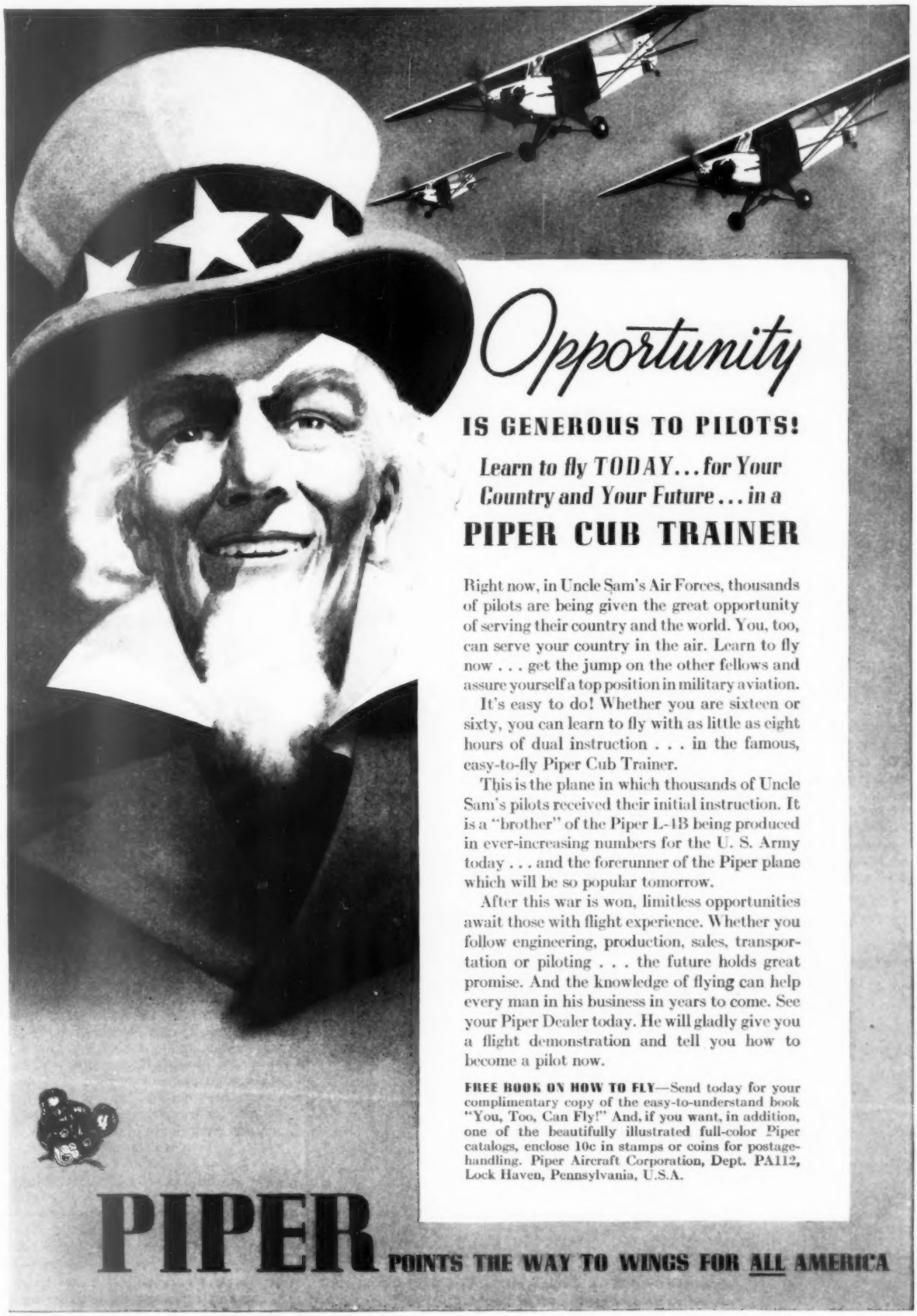
It sounds as if it would take a long time for all that to happen. I don't think it did. There was a slight time-lag undoubtedly. But a two minute, 360° turn started slightly late should bring me back beside the tower rather than straight into it. At its foot there was a cleared space as I remembered it. An emergency field? I didn't remember, but at least it was flat and clear of trees. And I wanted to *land*. I could only gamble, getting as near a standard bank as possible from the dim vision of the ghostly ground that was only a cloudy shadow below.

The gamble won. The beacon tower flashed even again. I cut the throttle, dropped a wing, gave full rudder, and side-slipped blindly. The snow-covered ground flashed up murderously. I jerked the ship level, gunned the motor, "schlooped" into the snow, throwing up a great white fan. The prop bit the drift, stopped. I was thrown forward against the safety-belt, shoving the stick against the panel. But the plane was solidly down in three feet of snow. It couldn't nose over.

I'm not sure how long I sat shivering in the plane. Things had happened too fast. One minute I had been flying with home so close I could smell a broiling beefsteak. And here I was suddenly on a lonely mountaintop with a ghostly skeleton of a tower looming behind me, its top almost lost in swirling snow. I sighed shakily and stepped out.

There was almost no wind now, but there might be before morning. Could the plane blow over, wedged as it was with snow? I didn't know, but it was an axiom that planes should be tied down in the open. I kicked the snow away from the propeller, shoved it away with my arms, carried it away. I swung the prop. The motor burst into its pleasant

(*Continued on page* 120)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## Escape from Java

(Continued from page 27)

about 140 miles from where we had started. We were in this place for about a week, just waiting for word to come through to tell us which port to go to.

We didn't know at the time that there wasn't an open port in Java.

At 10 p.m. on March 7, we received instructions that the town we were in was an open city, and we were to hand in our arms and await occupation. We asked the commanding officer of the unit if he would let a few of us escape as best we could. He said he would not, so we told him to come back in half an hour and we would hand over our arms. In that half hour we worked like mad, loading up the cars we had with food and ammunition.

We had a couple of machine guns and a couple of tommy guns and dozens of rifles. We had picked up the machine guns at a bombed-out drome near our camp in Buitenzorg.

We started out towards what we thought was the coast, but after going for about an hour we found we were going the wrong way, and that the only road led back through the town we had just left. So there was nothing for it but to turn and go back the way we had just come. Anyhow, the Japanese had not yet occupied the town, and we got through okay.

The road to the coast was over mountainous and very rough country, and it wasn't till daybreak we got there. On the way, we ran into another RAAF convoy parked by the side of the road. We told them the Japanese were on their way up the road, and advised them to get moving pronto.

On arriving at the coast we followed another road leading along the shore line, keeping a lookout for any boats. Close to a small native village called Pameunpeuk we found a deserted aerodrome with some damaged planes scattered over it. We continued down the road till it came to an end, and found a house to which a Dutch pilot and a Dutch army sergeant and his wife had managed to escape. The country all round was very hilly and covered in bush, which offered excellent cover for hiding.

These Dutch people said they were waiting for a flying boat, in which a friend of the Dutch pilot was going to escape to Australia. About 7 a.m. the flying boat showed up, but after circling a couple of times made off without alighting. All hope seemed to go then, so most of the boys got all the provisions together to make for the hills.

The Dutch pilot and four of us sergeant pilots, however, thought we would have another look at the airfield. We found one plane, a twin-engined job, with the tail busted off. The rest of it seemed all right, although it seemed unlikely anybody would leave an airplane in such a condition before evacuating the place. We tried to start the engines then, and as luck would have it they both started, and seemed to run reasonably well.

The machine was a Lockheed "212," a small commercial plane in peacetime, but it had been converted and made into a light bomber. The plane belonged to the Dutch and had their insignia painted on it. I learned later that it was the first "212" ever built by Lockheed and was delivered to the Netherlands Indies Air Force in April, 1939.

The plane was fitted up with a turret, but was minus a gun. Searching round the field again, we found another machine of the same type with the nose and wings smashed, but the tail was untouched.

Well, I think you can guess what we did. We all hit on the same idea at once. Why not swap the good tail of this one and put it on the other, giving us one good machine?

With the few tools we had, we started, and you can believe me I thanked God then that I knew a little bit about engineering and mechanics. I was using a sixpence for a screwdriver, and undoing ½-inch nuts with a pair of pliers, and getting myself tied up in knots with ball races, locking pins, etc. I'm sure I didn't know what they all were.

We found that the tail part of the good machine was strained out of alignment, and we finished up by tying it together with rope.

We found a couple of machine guns lying about and fitted them in the turret, and one in the nose, firing forward. Fortunately, we had brought plenty of machine guns and ammunition with us. There was plenty of gasoline lying round the field in drums, and we were able to fill the tanks with the aid of a pump we found.

Searching round the field again, we found a couple of spare wing tanks with a capacity of 40 gallons apiece. We strapped these tanks inside the fuselage with bits of bamboo and string, after plugging up some holes with corks and bits of wood.

I think the next bit of work just about took the cake, though. I bashed a hole in the side of the fuselage with the aid of a center punch and a pair of bolt cutters we found. We found a piece of bowser hose and fitted it through the hole and jammed one end in the tank in the wing. I fitted a steel rod from the fuselage to the tank and tied the hose to it so as to stop the slipstream from blowing it out. The idea was to feed gasoline through the hose (with the aid of a home-made funnel) from the tanks in the fuselage.

We finished everything about 9 o'clock the next morning and I can say we were pretty proud of our effort.

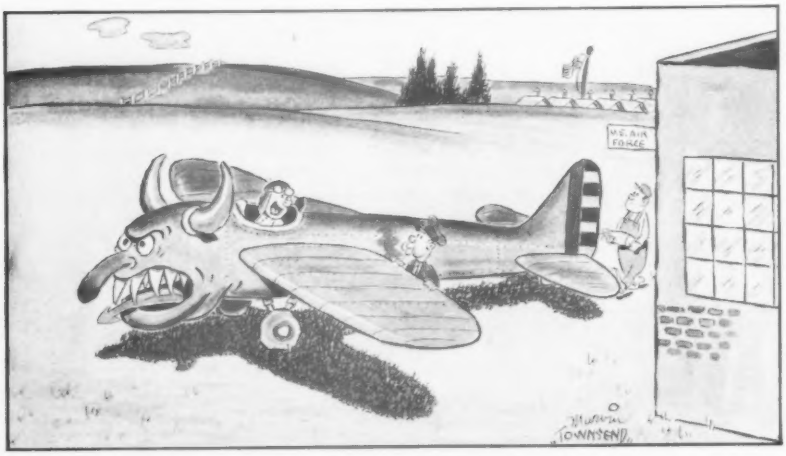
After figuring out the range of the plane with extra tanks, we found we could not quite make Australia, so we agreed the best thing to do was to fly up the coast of Sumatra and smash land on the beach when we ran out of petrol. Someone had said that the top end of Sumatra was still in Dutch hands, and it was about the only thing left for us to do.

While we were repairing the plane, word came through that the Dutch government had capitulated, and all the army were to proceed to Bandoeng to be demobilized. Before going, the Dutch decided to destroy the airfields, and a proper job they had made of the one we were on, too. They dynamited the whole field so as to stop any Japanese airplanes landing until it had been repaired.

We examined the field carefully and found that the only clear path ran in zigzag fashion, and even then was barely the width of the undercarriage. With an overloaded plane it seemed a 10 to one chance we wouldn't get off, but we had gone so far we were game for anything.

Then came the take-off from this ruined airfield in Pameunpeuk, Java. The Dutch pilot had flown Lockheeds before, although he had only 250 flying hours to his credit, so naturally he took control.

I never want to be in another take-off like that one. Mind you, we didn't know what sort of condition the plane was in structurally. We got to the extreme edge of the field and, with the Dutchman at the controls, revved the engines up full




"I don't know if it's a good fighter or not, but we'll sure scare hell out of 'em!"

*"Say, Captain . . . what side of the road do they drive on in Rio?"*

**Don't think the planes of the future** aren't *already here!* They are! But, of course, these giants aren't carrying pleasure cars and vacationists. Troops and jeeps and equipment fill their holds.

Just imagine the Day of Victory has already arrived. Visualize the multi-motor bombers and transports of today as fleets of freight planes and super liners.

As sure as Victory will be ours, the America that lies ahead will be a land that brings the horizon to your back door. It will be a land that leads mankind to a new concept of civilization. Today's production lines are geared to it. Today's Americans are working for it.

When the aviation industry was in knee pants, we of B. F. Goodrich started our aeronautical division. Planes were fragile, slow, unsafe. The pilots who flew them were daredevils. But every day some new miracle of ingenuity took place.

For example, from the B. F. Goodrich research laboratories came a new type of aircraft tire, a low-pressure Silvertown which made aircraft take-offs and landings smoother and safer. This helped pave the way for heavier planes. We developed a new type of brake that greatly increased a pilot's ground-control. This helped pave the way for greater speeds. We developed De-Icers, which protect wings, tail and rudder from ice.

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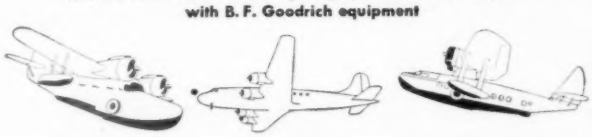
Here are some famous military cargo planes that are supplied with B. F. Goodrich equipment



GRUMMAN J R F

DOUGLAS C-54

VOUGHT-SIKORSKY J R S

*Skyway or Highway*

**B.F.Goodrich**

**FIRST IN RUBBER**

bore. When these were just about to shake themselves to bits, he let off the brakes and away we went. We zigzagged down the field with craters whistling by under our wingtips.

I can remember looking ahead, with a sick sort of feeling in my stomach, and thinking we wouldn't get off before hitting the fence at the far end. I still don't think we would have made it, had we not hit the lip of one of the craters, which bounced us into the air. As it was, we cleared the fence by inches, and got over the beach and out to sea.

We headed up the coast of Java, keeping well out to sea, although the Japanese must have seen us. Whether they thought it was one of theirs, or whether it was because of the cloud we were flying in, we didn't see any Japanese fighters on the whole trip. The plane had a good turn of speed. We cruised all the way at 210 m.p.h.

We flew up the coast of Sumatra, and after going about 800 miles, turned inland in the hope of finding a field or airfield to land on. If we found an airfield we were going to fly round to see if any Japanese airplanes were on the ground, or if anybody fired at us, so as to find out who had it.

After flying round for a while we came across a fairly large town on the edge of which we saw an airfield. We couldn't see any planes on it, so we flew over it at a good height and saw that it was all cluttered up with obstructions, so we guessed that it was still in Dutch hands. We couldn't see any life, though, so we took it for granted we had caused an air raid alarm.

We lowered our wheels and began to circle the field, waggling our wings all the time to make out that we were friendly. After awhile we saw some Dutch soldiers appear and stand gazing at us.

We came down low over the fields, just missing the obstructions. For a few minutes nothing happened, and then things started, so we guessed that someone must have realized what we wanted. Soldiers appeared as if by magic and began clearing away the obstructions. Cars began to come in from the city, packed with civilians, and in a few minutes there were hundreds of people clearing the field so that we could land. The trip from Java to Medan had taken us seven hours and 10 minutes, and when we landed we had just 10 minutes' gas supply left in the tanks.

From then on the Dutch treated us like kings. They took us to the best hotel in the city, and there they told us how lucky we really were.

It seems that about three weeks before some Japanese planes had come over with Dutch markings, making out that they were friendly. They had come in low and then bombed them to blazes. About a week later some real Dutch planes had come over and the Dutch, thinking they were the Japanese up to their old tricks, promptly blew them out of the sky. When we came over they were tossing up whether to shoot us down or let us land.

The next day we went back and started work again on our plane. We had decided to try to get to Ceylon. The governor had given us some codes, which we were to deliver to the admiralty (if we ever got there) so as to establish contact with Sumatra again.

We took off early in the morning the next day, just before the Jap reconnaissance plane was due to come over, and landed about one hour later at a place called Klug-now, on the northeastern tip of Sumatra. We had the same trouble landing as we did at Medan, but eventually we got down okay.

We had no sooner landed when the Dutch grabbed our machine and pushed it under cover, and threw camouflage over it, as they said the Jap reconnaissance plane was due over in five minutes. It seemed as though they set their watches by this airplane, for at exactly nine o'clock over she came. It circled us twice and then made off in a devil of a hurry.

We guessed the pilot had seen our plane, and was going back to get somebody to come over and drop something on us. We started filling up all the tanks as quickly as we could. I was a bit worried about one of the engines. It had heated up pretty high, and had chewed up a few gallons of oil on the trip up, but it was too late to do anything now, so I just filled her up with oil again, and left it at that.

We had just about finished when a lookout reported that nine Japanese bombers were heading our way. We filled up the tanks in double quick time, and threw in an extra nine tins for good measure. While we were doing this soldiers were pulling the camouflage off our plane and our Dutch pilot started the engines. Suddenly the Dutchman opened up and we started down the field for the take-off.

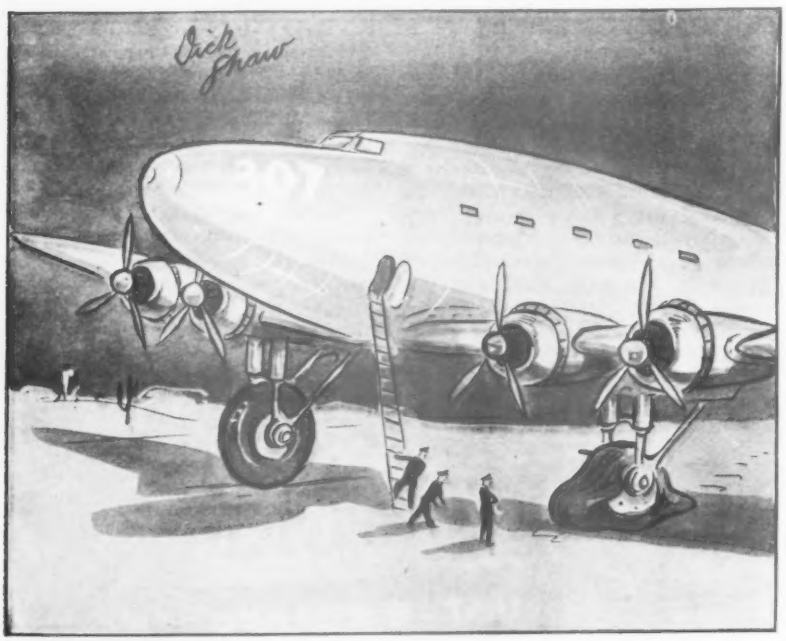
There was a stiff cross-wind blowing at the time, and half-way down the field we went into a ground loop. It was only by a very good piece of work on the part of the Dutchman that we didn't wipe the undercarriage off. Anyhow, it held, so we taxied down to the other end of the field with the intention of taking-off from that direction.

The prospect of this didn't look too bright, for right in front of us was a whopping big hill. Either we had to go over this hill or turn away from it as soon as we had got off the ground. Or if we tried to go over the hill and managed to clear it (which would have been a miracle in our overloaded plane), we would run straight into the Japanese bombers, which we could see heading towards us. So the only thing left to do was to try to turn as soon as we were in the air.

*We did it.* We must have missed the trees on the hill by mere inches. At any rate we missed them, and turned out to sea as fast as we could go.

The Japanese bombers were coming down on the field now, and were making their run across it. Two of the bombers, which were armed with cannon, must have seen us, for they came diving down on us. But, as luck would have it, we were just those few seconds too soon for them. We just managed to keep out of their range, and in the end gradually drew away from them. The old bus had a marvelous turn of speed when pushed for it and we owe our existence now to that. The Dutchman was giving her all she had, and try as they might the Japs were never able to catch us.

We set a course on what we thought was the right way to Ceylon. The only map we had was a map of the world,




"Oh, fudge!"

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Free literature on request showing all the various series of Lycoming radial and horizontally opposed aircraft engines and picturing many of the Lycoming-powered airplanes. Write Department P112,

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**LYCOMING DIVISION, THE AVIATION CORPORATION** **WILLIAMSPORT, PA.**

torn out of a magazine. We had no navigation instruments of any kind.

There is not much to say about the trip over the sea. We had a bit of a job transferring the gasoline from the cabin to the wing tanks, but in the end found that by banking the aeroplane over we could gravity feed it in. This maneuver didn't help us follow what we thought was our course to Ceylon, as everything looks slightly cockeyed at that angle, but we had to do it to get that extra gas that was keeping us out of the shark-infested Bay of Bengal below. We were aided by a small hand pump which we had found lying on the field.

It was well into the afternoon when we did sight land. I was at the controls myself at the time, and the first thing I saw was a convoy going the same way we were. It was not long after that that we saw land.

After flying down the coast a while we knew it was Ceylon. We headed inland, and ran slap bang into some hills and a hailstorm. Eventually we hit the opposite coast and followed it down in the direction of Colombo. We soon saw a large town and seaport ahead, and then we had an uncanny bit of luck.

There were a large number of destroyers and naval craft in the harbor at the time, and on sighting us coming towards them they started to challenge us with the signalling lamp. The correct thing to do when challenged is to fire what we call "colors of the day" with a Very pistol.

We had a Very pistol on board, and several cartridges, but of course we didn't know what colors to use. There are dozens of colors to choose from, and they change the color every day. We had to shoot something off, so I picked up a two star red, fired it off and waited. I thought this was as good as any, as red is more or less a mercy signal, or used when you are in danger.

We expected every gun in the harbor to open up on us, but nothing happened. We flew round the town looking for the landing field, which we found by following another plane in. We landed okay, and you can bet we caused a bit of a stir when they saw a strange plane come in bearing the Dutch insignia. We landed with just 15 minutes' gas supply in the tanks.

We found out later that the colors of the day were two star red, just what we had let off!

That was the end of our journey by air. I was the only New Zealander to get out of Java after the capitulation of the Dutch. The Dutchman had to stay in Ceylon, and the Canadian was able to rejoin his squadron in Bombay. So the two Australians and myself got on a troopship bound for Australia.

END

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**REARWIN AIRCRAFT & ENGINES, INC. Kansas City, Kansas**

## They Keep Them Flying

(*Continued from page 55*)

ing brakes, and see that the switch is off!" the crew chief warns a relatively inexperienced hand who nine months or a year from now may himself be the boss of a small group like this.

Methodically, each man pursues his task. One pulls the propeller through several times to check compression, then observes the blade for nicks or cracks, and makes sure of the prop's security on its shaft. Firm attachment of the engine cowling is checked. In swift, smooth succession the following is performed:

Lading gear is checked for defects, tires for proper inflation, flying wires for tension. The airspeed pitot tube cover is removed and the opening checked for freedom from obstructions. Wings are inspected for fabric tears, security of underside inspection cover plates, security and tension of landing wires and wire fairings, and free movement of ailerons.

The fuselage is checked for evidence of buckling or obvious "pulled rivets." Stabilizer is observed for rigidity, and brace wires for tension. The men make sure that elevators and rudders have freedom of movement. Tail wheel is checked, as is tail cone for items that might foul controls cables. Steerable unit must be engaged after its operation is checked.

Fuel supply is measured, windshields and cockpits are cleaned, and the space under torque tubes is noted for obstructions, such as scraps, nuts or bolts left from previous mechanical inspections which might prevent proper movements.

Instruments are inspected for proper pointer position and loose or cracked glass. Safety belts are checked, as are all flight controls, which must be moved to their full extent of operation several times.

Now the engine is ready for warm-up, during which magnetoes must be checked at proper r.p.m.

A practiced maintenance crew can perform all these operations in from five to 15 minutes. But this is the most elementary of all flight inspections.

Every 25 hours of flight time requires a more thorough, searching investigation of the plane's condition. Every 50 hours, the plane is scrutinized still more painstakingly, and the 100-hour check will take a three-man crew eight hours to complete.

A primary trainer is kept flying under this maintenance system for 400 to 480 hours before the engine is transferred to the overhaul section for virtually complete rebuilding through replacement of every worn part; and the plane itself is stripped and overhauled after 1,500 hours.

But we still haven't considered the daily inspection, which keeps one mechanic occupied as long as two hours at conclusion of a full day's flight operations. A brief view of this inspection will serve to give insight into the 25, 50 and 100-hour inspections, each of which is more thorough application of the prin-

# "我々に對してこんな仕打 は出來ない筈だ！"*

*Oh can't we—Well, wait 'til the count is all taken!—Tokio at high noon—Bataan in the dusk—the Marshall Island Raid...those little affairs of the Coral Sea and Midway, remember? These and countless unsung incidents of high adventure are being written in letters of fire by our Air Forces personnel. This modern saga of American courage and daring emphasizes once more the deeds which throughout our nation's history have surmounted the impossible. ☆ ☆ ☆ Of particular significance to all those interested in flying, is the fact that many of these pilots who constitute our first line of attack, in the rapidly growing offensive, received their first flight training on Aeroncas. ☆ ☆ ☆ Aeronca takes pride in its job of producing trainers to Air Forces specifications that continuously redeem its pledge of "First and Finest." Aeronca Aircraft Corporation, Middletown, Ohio.*

*Translation—"To we honorable people they can't do this!"

AERONCA

## The Aeronca Victory Award

**The Aeronca Aircraft Corporation pledges its entire resources of equipment and experience to produce only the finest in material and manufacture for the men who are privileged to fly for their country. ☆ ☆ ☆ ☆ The — Aeronca Victory Awards — presented to employees for skill that develops better products or creates time-saving operations — are our dedication of an "all out" pledge to win the war in the shortest space of time.**

AERONCA

ciples of the daily routine operation.

Form 1—the ever-present flight record book in which the pilot has jotted down anything unusual regarding performance of the plane—is carefully read and all new information is transcribed to Form 41, the massive maintenance record sheet kept in the hangar which notes the condition of every feature of the engine and plane through a 90-day period. This form, as well as the log book, follows the plane wherever it may go, and provides a biography with a universal language that tells mechanics anywhere just what has been done to the plane and power plant in their lifetimes, and what needs to be done.

Then the cowling is removed, cleaned and inspected for possible cracks. "See that the cowling is not rubbing cooling fins," reads the maintenance "bible" at Ryan. "Check for broken or damaged baffles; remove and clean carburetor air intake screen."

All spark plug wires are unfastened, propeller is cleaned and inspected for security or tightness on shaft. Tipping is checked for cracks along the leading edge at rivets. The prop is coated with light oil, and the inside of the shaft is cleaned and oiled at the hub-retaining nut. As in the morning, the propeller is pulled through to check for compression and blow-by.

Crankcase and nose section are observed for cracks before the engine is wiped down, and evidence of oil-throwing is watched. In cleaning the engine, the mechanic is instructed to inspect cylinder hold-down nuts for tightness, and rocker box covers for security, safetying, and rocker arm shaft for security. Cracks at the welds particularly are checked in the engine mount and in ring cowls, exhaust stacks, collector ring, shrouds, intake pipe, and starter case, where oil leakage will betray a fault.

All lines, joints and fittings of the fuel system are inspected for chafing, cracks and leaks. A particularly close check is given the carburetor for leaks at the parting surfaces, cracks at the neck or mounting flanges, and to make sure that the carburetor drain plug and screen plug are properly safetied. The tank vent is noted for obstructions. As with the fuel system, oil lines, fittings, pumps, valves and plugs of the lubrication system are carefully inspected, and the fluid level in the brake reservoir must be kept at least one-half full.

Other work must be performed as follows:

Ignition system: inspect magnetos for security, and for looseness in coupling; check ground wire to switch, both at magnetos and engine, for security; check ground and magneto leads at switch.

Engine controls: check throttle operation for freedom, security and full travel, all bolts at ball bearing terminals and bell cranks for security, all jam nuts for tightness; see that mixture control is safetied in full rich position; check operation of carburetor air heat control; inspect fuel control cock shaft for wear at firewall, and handles for looseness.

Landing gear: inspect wheels for side play, tires for inflation, cuts, abrasions, wear, etc., oleo struts for leaks, brace and flying wires; check terminals for nicks, cracks, rust, and place light oil coating; check hydraulic brake lines for leaks.

Flight and control surfaces: check stub wing for pulled rivets, clean and check wing fabric for damage, check inspection plates and fairings for security, ailerons and flaps for excessive play, looseness and freedom of movement; clean and inspect stabilizer and elevators for fabric holes in underside; clean and inspect stabilizer brace wires for damage.

Tail gear: check steerable unit for operation, and play or looseness in tail post or shock strut, tail wheel for side play, tail wheel tire for cuts, etc., and both sides under tail cone for any object that might foul controls.

Fuselage: inspect for pulled rivets, evidence of buckling, and cracks at rivets holding mounting brackets to skin.

Every detail of plane and engine must be recorded on huge maintenance chart.

Cockpits: inspect instruments for proper pointer position, markings, cracked or loose glass, and instrument panel for security of mounts; note condition of skin from inside, condition of floorboards, and bulkheads; check brakes and pedal adjustment for proper operation, visible control cables for security, flap handles for looseness, seat and safety belt for security.

Flight controls: check operation by moving all to full extent several times, noting movement and position of corresponding surfaces; inspect space under seat to make sure that nothing has been left to foul control horns; see that tab control operates correctly.

Maintenance workers often say they work in the "grief department" and after perusing the almost infinite detail of just the pre-flight and daily checks, I think you'll be inclined to agree. Especially since they're merely the foundation for the more elaborate periodic checks.

Army maintenance practice requires the "daily" inspection at least once a week, and a 25-hour inspection at least once a month, whether the plane has flown or not, and regardless of its total flying time.

The army refers to any repair or replacement that can be performed with hand tools and affects no more than five percent of the surface as first echelon maintenance. Anything beyond that becomes second, third, or fourth echelon maintenance, and is a job for the overhaul or major repair crews of more experienced mechanics. Any work which alters a plane's rigging or engine to the point where aerodynamic characteristics are affected must be checked in a test flight.

Twice a year, a high ranking officer of the Air Forces visits an operating unit such as Ryan, scrutinizes the maintenance and flight records, and almost intuitively observes whether rigid Air Force standards are being followed. This task becomes more complex as size of the planes increases. Detailed as is the maintenance of a primary trainer, consider the task of crews on aircraft with an array of auxiliary equipment, including bombing, gunnery, tow target, chemical, communications, photography and navigation. And high altitude planes with superchargers present still more problems.

Parachutes, as well as airplanes and engines, come under the jurisdiction of the maintenance department. The canopies must be broken out of their packs and aired at least once every 60 days, hung in a special drying cabinet to remove all moisture and prevent mildewing. As with the airplane and the engine, a complete record of all work performed on 'chutes is kept on a permanent record. Fitted inside the pack cover is a record of the repacking dates and the name of the parachute rigger accomplishing the work.

When life threatens to become monotonous for a maintenance crew, it usually is jolted out of complacency by a technical bulletin issued by the Air Forces headquarters and describing changes that must be effected immediately in a particular installation. Decided upon after constant observation of operations, and designed to improve upon performance of that type plane, these alterations must be performed while the run-of-the-mill upkeep in schedule is maintained.

An apprentice mechanic requires at least three months before he can be entrusted with any responsible duties in maintenance. Most of these "grease-monkeys", youngsters in their late 'teens and early twenties, become fairly reliable after nine months of constant application.

Because it has been virtually impossible recently to obtain sufficient men with at least one year's mechanical school training and an A and E (airplane and engine) license, the Army today issues a civil airman mechanic rating

(*Continued on page* 80)

★ From the ashes of war's destruction shall rise a greater mode of transportation — the "*merchant aerine.*" Already the logistics of global warfare are requiring aerial armadas of military cargo-planes. When peace returns, they will have proved that flying freighters not only have greater speed and mobility, but also carry cargo at a low cost per ton-mile.

Aerols* enable these air leviathans to take-off and land with complete safety and efficiency. By cushioning the landing shock with hydraulic-pneumatic action they protect the plane, crew, and cargo. Aerols are also used on all other kinds of war planes — from the fiercest fighters to the biggest bombers, on every terrain and in every climate. Thus Aerols serve the cause of Victory today. Tomorrow, they will render an even greater service when the skyways are filled with fleets of flying freighters.

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*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL" — THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

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It means that billions of dollars are being diverted from "bidding" for the constantly shrinking stock of goods available, thus putting a brake on inflation. And it means that billions of dollars will be held in readiness for post-war readjustment.

Think what 10% of the national income, saved in War Bonds now, month after month, can buy when the war ends!

For Victory today . . . and prosperity *tomorrow* keep the War Bond Pay-roll Savings Plan rolling in *your* firm. Get that flag flying now! Your State War Savings Staff Administrator will gladly explain how you may do so.

If your firm has not already installed the Pay-roll Savings Plan, *now is the time to do so.* For full details, plus samples of result-getting literature and promotional helps, write or wire: War Savings Staff, Section F, Treasury Department, 709 Twelfth Street NW., Washington, D. C.

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# Liberty Ship—World War 2

WEIGHING only a little less than a whole squadron of fighters, the Consolidated Coronado (PB2Y), is a Liberty Ship in every sense.

Whether convoying troopships and supplies, patrolling vast reaches of ocean, or bringing her tremendous fighting power to bear on the enemy, the Coronado is a magnificent weapon in Democracy's fight for decency.

These flying task forces, biggest planes in service with the U.S. Navy, are being turned out by Consolidated's thousands and thousands of workers . . . men and women who are building *and* buying them for Uncle Sam because they believe in Liberty. *Consolidated Aircraft Corporation, San Diego, California. Member, Aircraft War Production Council, Inc.*

*Floor-board Freddie . . .*

FLOOR-BOARD FREDDIE WOULD ALWAYS SAY,
"IT DON'T HURT IT NONE TO FLY IT THIS WAY."
HE'D GIVE IT THE NEEDLE TO MAXIMUM GOOSE--
THEY NEVER FOUND OUT WHAT FIRST BUSTED LOOSE.

*Reproduced in the interest of safety, by permission of the Army Air Corps.*

## CONSOLIDATED* builds Battleships of the Air

*Originator of the LIBERATOR . . . CATALINA . . . CORONADO

(*Continued from page 76*)

which qualifies one for ground crew work beyond the apprenticeship stage.

After at least six months' experience, the rating can be attained by mechanics able to pass practical and theoretical tests on the plane they expect to perform maintenance duties. At Ryan, mechanics daily attend classes for instruction leading to the c.a.m. ratings and a possible job as crew chief.

Though the Army lays down certain rules, the mechanic sometimes must use his own common sense and ingenuity to keep a plane in operating condition. When the flight department orders a certain number of planes for the next day's training, at least that many must be on the flight line. Alibis are outlawed in the Army Air Forces these days.

I'll stack the loyalty and willing spirit of cooperation of our flight maintenance crews against any aviation group. This was not better demonstrated among our mechanics than in the manner they reacted to a sudden order to vacate the field from which the Ryan primary trainers had always operated.

The order, issued to make way for other equipment unexpectedly assigned to the area, was received by the maintenance department at 11:30 in the morning. By two that afternoon, our men were cheerfully conducting maintenance at another field, almost six miles away, performing under the most primitive operating conditions. There was no hangar, no maintenance facilities whatsoever. All necessary equipment had been moved in less than two hours, and that day and night the maintenance program on more than 30 planes was continued uninterrupted, permitting smooth functioning of the cadet training schedules.

END

## Air Empire

(*Continued from page 40*)

ordered reduced mail compensation to the company on its Latin-American operations. The new rates are estimated to contribute $1,771,000 a year from September 1, 1942 for carrying U. S. mail. In addition, the company will receive about $1,773,000 in direct payments from foreign governments in this same operation. The extent of decreased mail revenues from Latin-American operations is evident when it is realized that during 1941, the company received $6,910,000 for carrying the U. S. mail. The Board estimated the mail pay reduction at about $3,366,000 on an annual basis. The CAB further noted that increased war traffic resulted in excess earnings of about $4,356,000 on an average investment of $8,442,000.

The Colombian Republic in May, 1938, enacted a law requiring that by May 26, 1942, not less than 51 per cent of the stock of any Colombian air line must be owned by nationals of Colombia and/or the Colombian government. During 1940, Pan American's interest in a foreign subsidiary operating in Colombia, and known as Avianca, was reduced from 80.28 per cent to 64.224 per cent. Ultimately, it is proposed to reduce this to about 28 per cent of the outstanding stock of Avianca.

The importance of Avianca may be indicated by its contribution in previous years to the consolidated profit and loss accounts of Pan American Airways. For the years 1936, 1937, 1938 and the nine months ended September 30, 1939, the respective amounts were: $106,839; $215,534; $261,562 and $102,002. By looking at Table 2, it may be noted that Avianca made some substantial contributions to the net income of the Pan American Airways system. For example, were it not for Avianca, a sizeable loss would have been reported for the year 1938.

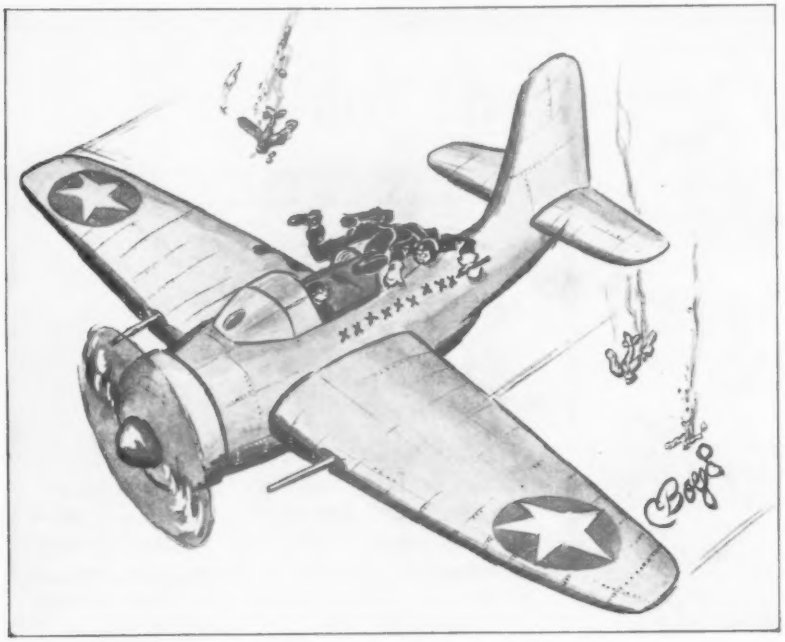
As of December 31, 1940, Avianca owned 24 of the 105 planes in the possession of Pan American subsidiaries. Moreover, this Colombian unit is estimated to have flown about 10 per cent of the Pan American system's revenue passenger miles in recent years.

The initial years of operating the Pacific routes were mainly responsible for the substantial inroads made into the parent company's earnings (supplied primarily by the Latin American division). The first full year's operation in the Pacific, 1937, lost about $500,000. Another $1,150,000 lost in this operation during 1938 may be largely attributed to the war in China and the loss of the *Hawaiian Clipper*. Despite an increase of $1,100,000 in annual mail pay (effective April 1, 1939) and back mail compensation of $493,300, the Pacific division lost about $200,000 annually during 1939 and 1940.

Final air mail rates were also established for the company's Pacific routes in a CAB action a few months ago. The original Pacific rate was $3.35 per mile between the United States and Manila, plus $4,950 per outbound trip Manila to Hong Kong. The new rates were segregated for the north Pacific and south Pacific. The former operation is to receive $2.0021 per plane mile from November 1, 1940, to December 13, 1941. This new rate schedule is academic in view of the suspension of operations over this segment. The south Pacific route calls for a new rate of $3.1112 per airplane mile. While these new rates cover more mileage, the company will ultimately receive less mail compensation than previously in view of the lower base rates established.

In China, Pan American's 45 per cent-owned affiliate, the China National Aviation Corporation, has been known to have been operating schedules at near capacity in Chinese-held territory. As late as 1939, an additional route was placed in service to Rangoon, India, and another to Hanoi, French Indo-China. Of course, these new routes—and possibly others—are now out. The indications are that this company had been experiencing highly profitable operations in recent years. It is believed, however, that operations are being conducted in Chinese paper dollars, making withdrawal of profits rather difficult. The Chinese government owns the remaining 55 per cent of the stock of China National Aviation Corporation. This unit should have untold post-war possibilities in view of the almost complete lack of communications and transportation in China.

Pan American-Grace Airways, Inc., known as Panagra, which connects with other Pan American services at Cristobal, C. Z., serves the west coast of South America and has been in the forefront of wresting control of western routes from German-controlled companies. This is illustrated by the fact that German routes of 11,500 miles at the outbreak of the war in September, 1939, have been cut to 70.



"If you're going to get any more, get them while I'm out here!"

# *Out of Range!*

ABOVE the war clamor for air-borne cargo this fact stands out crystal clear: Douglas has built, is building and will continue to build in ever greater volume two and four engine cargo carriers that *today* are "delivering the goods" out of the range of submarines. Already bridging time and distance in this global war, Douglas fleets of combat transports will soon become mighty airmadas of supply to overwhelm the enemy wherever he may be.

Douglas Aircraft Company, Inc.

**DOUGLAS**

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

WAR TRANSPORTS: DC-3 • C-47 • C-54 BOMBERS: A-20 • "BOSTON"
BOMBER-FIGHTERS: SBD "DAUNTLESS" • "HAVOC" • TBD "DEVASTATOR"

Panagra in the meantime increased its mileage from 4,500 to more than 15,000 in the five western nations—Colombia, Peru, Ecuador, Bolivia and Chile. Further extensions by Panagra are believed to have since been made with the grounding of the remaining Axis-controlled air lines.

This expansion by Panagra assumes added significance in view of the recent attempts by the W. R. Grace group to dis-associate its interest from Pan American Airways. Late last year, Grace filed an application on behalf of Panagra to extend the latter's service into the United States. The application, among other things, stated: "Petitioner has been unsuccessful in its efforts to secure authorization from the Board of Panagra for Panagra to file an application for the New Orleans route or for connecting service via Miami and is for that reason obliged to bring the matter before the Board [CAB] on its own motion." The petition went on to say that Panagra's "great international trunk line" should have a terminal in the United States, and that this terminal should be Miami, Tampa or New Orleans. Complaint is made that connections from Miami have been slow and that further schedule changes will merely accentuate this difficulty.

TABLE 1

FOREIGN AIR MAIL PAYMENTS AND REVENUES U. S. POST OFFICE DEPARTMENT

| Years Ended June 30: | Total Mail Pay | Total Revenues | Subsidy to Foreign Air Mail Carrier* |
|---|---|---|---|
| 1941 | $17,333,961 | $9,309,793 | $8,024,168 |
| 1940 | 12,424,722 | 7,272,130 | 5,152,592 |
| 1939 | 9,224,818 | 4,403,160 | 4,821,658 |
| 1938 | 8,579,525 | 4,170,517 | 4,409,008 |
| 1937 | 7,880,001 | 3,864,140 | 4,015,861 |
| 1936 | 6,610,271 | 2,685,149 | 3,925,122 |

Source: Post Office Department

*Virtually all of this subsidy may be assumed to have been allocated to Pan American Airways.

This evident friction between the two partners of Panagra is bound to leave some permanent repercussions on the Pan American Airways system. As a matter of fact, Pan American Airways recently sought, and an examiner recommended, that it be awarded a New Orleans-Guatemala City line. This could be served as a direct encroachment on Panagra, if so desired.

Panagra has proven to be a highly profitable development for Pan American Airways Corporation. During its existence of about 13 years, Panagra has given Pan American Airways an equity in earnings totalling more than $3,000,000. This includes actual dividends of $707,500. In addition, management fees of more than $600,000 were paid Pan American Airways. All this on an original investment of $500,000. Not only will these material earnings be lost should Panagra be dissolved, but Pan American Airways may suffer additional losses by virtue of possible intensified competition from interests which were once its allies.

All the separate operations described in detail find their way to the composite whole which appears as the consolidated financial report of the Pan American Airways Corporation.

Profitable operations have been reported by Pan American in every one of the past 12 years. For the calendar year 1941, total revenues reached a new peak of $38,957,086—or almost twice as much as shown for 1939.

Net income of $3,361,252 for 1941 surpassed 1940 results by almost 50 per cent.

In March, 1940, a total of 525,391 shares of additional stock were sold to provide $6,250,000 and increased the total stock outstanding to 1,887,365 shares. In addition, 50,000 shares were purchased under option at $12.50 per share by Juan T. Trippe (Pan American's president) February 28, 1942. The stock is currently selling around $18 per share. In addition, a total of 62,645 shares were allotted in connection with the company's management stock purchase plan at $12.50 per share, exercisable during the four month period to end October 31, 1943. At last reports, the company had 1,937,355 shares outstanding with 6,989 stockholders.

The company paid a dividend of $1.00 per share during 1941, the first since November, 1938, when 25 cents per share was disbursed.

Net working capital amounted to $2,897,372 as of December 31, 1941—a decided improvement over the $98,633 reported two years earlier. The various units of the company last reported commitments for approximately $42,555,000 towards the purchase of flight equipment and for airport improvements.

Pan American Airways also did some pioneering in aviation finance. In January, 1939, the company was the first to apply true aviation equipment trust financing, similar to the "Philadelphia Plan" used in the railroad industry. In order to help pay for its new fleet of Boeing *Clippers*, the company issued $2,500,000 in four per cent equipment certificates to two New York banks. Subsequently, an additional $1,000,000 of certificates were sold to an insurance company. Pan American paid 30 per cent of the purchase price of the equipment in cash, the remaining 70 per cent becoming available through the sale of the certificates. The chief difference between equipment trusts for railroads and the issue established for PAA is that the period to final maturity for railroad equipment trusts extends over 10 to 15 years, whereas for the new planes of Pan American, the term is limited to five years. The principle involved is the same, i.e., payments by the operating company shall have retired, during the useful life of the equipment, the entire amount of the securities issued. However, studies have already indicated that these Boeing planes are expected to have a longer life expectancy than five years.

It is an interesting sidelight to note that most aircraft manufacturers that sold planes to Pan American Airways lost money on the transaction. United Aircraft, Martin and Boeing all attest to this experience.

Now Lockheed has consented to build a new type plane for Pan American, the *Constellation*, which was previously reported ordered to the extent of 40 planes. It is described as a four-engined superplane providing "speed, range, and carrying capacity superior to any transport aircraft known to be planned for production."

The charge is frequently made that Pan American is using the present emergency to firmly entrench itself as a monopoly in the international air routes. While American Export Airlines was granted a certificate by the CAB authorizing regular transatlantic service, the Senate subsequently refused to appropriate the necessary funds. This action was directly charged to the lobby maintained in Washington by Pan American. It is now reported that Export is flying the Atlantic under an arrangement with the Navy.

Interestingly enough, American Export's banking connection is Lehman Brothers. This same banking firm has an important interest in Aviation Corporation which owns 183,477 shares (or about 10 per cent) of Pan American's outstanding stock. In addition, Lehman Corp., an investment trust affiliated with the same interests, owns in its own right 20,000 shares of Pan American.

President Trippe is cognizant of the competition to come. He stated not so long ago that were it not for the war, three nations and perhaps six, would now be participating actively in scheduled operations over the North Atlantic. Perhaps five nations also would have established South Atlantic operations.

Thus, it is likely that at the conclusion of the war Pan American's transoceanic monopoly will be seriously threatened not only by American carriers but by foreign enterprises as well. At that time Pan American will have need of all of the resourcefulness which has made it the world leader in international flying.

END

TABLE 2

PAN AMERICAN AIRWAYS SYSTEM

| Years Ended Dec. 31: | Total Revenues | Net Income | Route Miles | Passengers Carried |
|---|---|---|---|---|
| | (000 omitted) | | | |
| 1941 | $38,957 | $3,361 | 98,582 | 375,732 |
| 1940 | 27,334 | 2,256 | 72,615 | 285,096 |
| 1939 | 20,611 | 1,984 | 62,305 | 246,295 |
| 1938 | 16,073 | 47 | 53,548 | 223,468 |
| 1937 | 14,729 | 510 | 52,567 | 214,170 |
| 1936 | 10,917 | 955 | 40,896 | 166,468 |
| 1935 | 10,127 | 1,194 | 40,479 | 143,283 |
| 1934 | 9,642 | 1,064 | 31,259 | 107,762 |
| 1933 | 8,387 | 898 | 30,982 | 76,100 |
| 1932 | 8,992 | 699 | 26,652 | 58,605 |
| 1931 | 7,914 | 105 | 20,664 | 40,676 |
| 1930 | 5,610 | d 576 | 17,861 | 34,748 |
| 1929 | 4,034 | d 317 | 12,265 | 20,728 |
| 1928 | 299 | d 30 | 251 | 9,500 |

d—deficit

## To Study Air Cargo

PRELIMINARY plans for solution of engineering problems which must precede large-scale development, both of wartime transportation of military supplies and personnel and peacetime movement of express and freight cargoes by plane, will be considered at an air-cargo engineering meeting in Chicago, Ill., December 8 and 9. The meeting will be under the auspices of the Chicago Section, Society of Automotive Engineers, with the co-operation of SAE aircraft and aircraft-engine activities.

*Army Airacobra on a Fighting Front*

## HE'S BETTING *PLENTY* "on the Nose"

Sent "upstairs" to destroy an enemy attack, this flyer is placing his bets "on the nose" of his Army Airacobra.

For firing through the nose of his sleek and speedy fighter is a mighty cannon. A single shot, struck home, will blast the biggest bomber from the sky.

When plans were laid to build this "flying cannon" no gun so large had yet been mounted in a single-engine plane. And Bell Aircraft, too, did its betting "on the nose." We set a cannon out in front then built a fighter plane around it. It was a new and untried theory that called for pioneering skill and engineering genius.

Theorists said it wouldn't work—scoffed at the thought—while a staff of able aircraft engineers, assisted by our Army Air Force, set out to do the job.

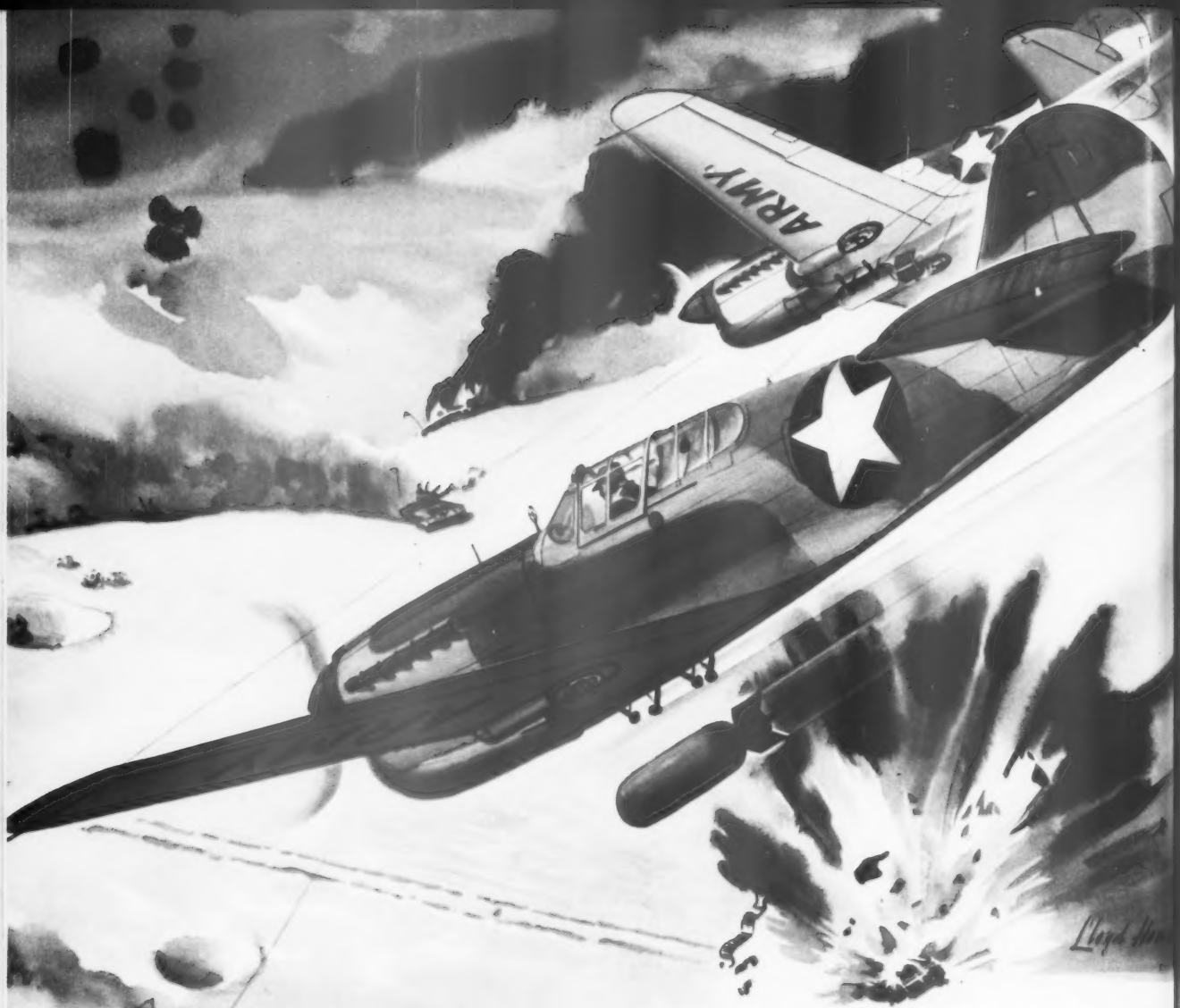
Our answer is the Airacobra—the only single-engine fighter of its kind. With engine "aft" the pilot sits behind his cannon, as though he rode the breech, so deadly accurate is his aim. With all at stake he's betting plenty "on the nose." © Bell Aircraft Corporation, Buffalo, New York.

*Airacobras for victory—*

FUTURE PLANES FOR PEACE

**BELL** *Aircraft*

**PACEMAKER OF AVIATION PROGRESS**

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**1932** • The first Curtiss plane designed specifically as a fighter-bomber... a single seater, it was used by the U. S. Navy for operation from aircraft carrier.

**1937** • First fighter-bomber to use retractable landing gear—used by the Navy and by China, Argentina and Siam. Wing bombs were also carried.

**1938** • The Hawk 75...a monoplane fighter-bomber, incorporating heavier defense armament, increased maneuverability and carried a greater bomb load.

**1940** • Curtiss P-40 To hawk...equipped the R. in the middle East and American Volunteer Grou China, Java and Burma.

## You Still Can Travel by Air

(Continued from page 26)

can be no assurance how long it will remain this favorable. The eventual official goal is to devote virtually all air travel to war purposes and if the need prevails there can be no logical quarrel with the aim. In the meantime, from time to time on certain schedules there have been lots of airline seats remaining for the general traveling public. Too many, from the lines' point of view, are still unoccupied.

Altogether the domestic air carriers seem to be making their difficult adjustment to war considerably better than might have been anticipated. At the close of 1941, a high water year for peacetime air transport, they were operating 351 airliners, including 224 Douglas DC-3's, 45 Douglas sleepers, and a flock of various type Lockheeds, Boeings and Sikorskys. Now only about half (or fewer) of these are in service, the rest being integral parts of the equipment of the Army's new Air Transport Command or being flown by the lines for the Army as cargo carriers. But on the whole the remaining commercial air service is a good deal better than half as good as it was.

The lines definitely are being more efficiently used than ever before. The explanation is fewer empty seats, fewer "no shows"—as the airline people dub prospective passengers who make reservations and then fail to use them—public recognition that air travel for frivolous purposes is not in accord with wartime necessities, tighter schedules and an improved official system of priorities for passengers and urgent cargo.

How much more efficiently the airliners are employed now that they are fewer is indicated by official figures for the so-called load factor, or the percentage of possible useful load that is carried, along with the total number of passengers transported. Because of military restrictions, the figures no longer are published, but those for the final five months before the ban was imposed last spring show the trend: In November the load factor was 53.26 and 301,878 passengers were carried; for December the figures were 55.39 and 278,583; for January 54.72 and 279,607; February, 55.78 and 263,589; and for March there was a jump upward to 66.57 and 344,769.

The load factor has mounted further since then, it is safe to assume. It was 97 per cent on one busy route out of the national capital this summer.

Several months ago there was a widespread impression among officials that while priority passengers were increasing in number they still represented less than half of the total traffic. On one line they comprised last June only seven per cent of the travelers.

This matter of priorities is nevertheless the biggest present factor in airline operation and in any discussion of who rides the air routes as passengers in wartime. To be sure of a seat you must have a priority status and a certificate of evidence, and to acquire a certificate you must have a recognized connection with the war effort, in what manner will presently appear.

To assure the speedy transportation of vitally important passengers and cargo, priorities machinery was set up hurriedly last February. It creaked pretty badly at times. Too many officials and agencies in Washington and in other cities could issue certificates which the lines had to honor. Too often the decision was left to the lines themselves, which were at a loss at times to identify those entitled to preference in reservations. It was hard to call the bluff of an officer in uniform who argued positively he was traveling on urgent war business even though he submitted no proof and really might be merely returning to his post under no compelling necessity for speed.

"Mrs. Flaherty, I dropped by to see if I could borrow a cup of oil and half a dozen bolts."

Then, after several false starts, a new revised system was put into effect in August, and the tentative verdict almost immediately was that it promised to end much of the confusion and ills of the former arrangement.

Briefly, the remade machinery provides for the extension of priorities only to persons engaged in essential war work, with civilians on an equal footing with members of the armed forces, to other qualified employees of the Federal Government, and to vital cargo. Top officer of the new Air Transport Command is Maj. Gen. Harold L. "Bombardment" George. In direct charge of the new priorities section is Col. R. W. Ireland, peacetime traffic manager for United Air Lines, who likewise headed the air division of the Transportation Service, Services of Supply.

Instead of being cleared through Washington, as was necessary in virtually all instances in the past, priorities now are to be issued through the Air Priorities Section, Air Transport Command and fourteen regional air priority control offices established or in process of establishment throughout the country. These field offices were assigned to New York, Washington, Miami, Memphis, Dallas, Kansas City, Chicago, Detroit, Pittsburgh, Los Angeles, San Francisco, Seattle, Denver and Dayton. Each is headed by an Army officer, with a small staff to aid him in maintaining service in some offices on a 24-hour basis. In various other key cities are local air transport representatives, usually airline people acting for the Government to help administer promptly all problems which arise.

The regional offices provide "on the scene" authority to establish and approve priorities, acquaint local war plant officials with means of obtaining essential priorities quickly, and to take the necessary steps to prevent unauthorized persons from obtaining the right-of-way travel status. After priority certificates are granted, reservations for seat or cargo space are made directly with the air carriers through their regular established agencies, just as in the past. The new classifications—or orders of procedence for travel—are:

1. White House personnel or others for whom air transportation is directed for accomplishment of a particular mission by the President, the Secretary of War or Secretary of the Navy.

2. Ferrying pilots of the Army, Navy and Marine Corps whose orders specifically direct travel by military or the fastest available commercial aircraft.

3. Army, Navy, Marine Corps, Coast Guard and allied Government military personnel or others whose air travel is specifically ordered, and civilians whose air travel is essential to expedite war production, construction or other similar activities.

4. Army and Navy equipment, ammunition, supplies and materials when certified by an appropriate Government agency as being essential to the war effort.

To guard against abuses, an official directive details the operation of the new machinery thus:

"These priorities will only be authorized for urgent passenger travel or shipments vital to the war effort; they will not include usual inspection trips except

for highest officials engaged in the war effort. Merely because an individual is a member of the armed forces or is engaged in war work will not in itself entitle him to priority in the use of air transport. Priorities will not be granted where the mission of the individual can be satisfactorily accomplished if travel is performed by train.

"Priority for air trips requiring less than two hours and where destination can be reached by rail within six hours of departure time from originating point will be granted only upon specific approval" which "will be given only in cases of emergency."

Most of the certificates which the airlines must honor presumably will be of the class three, four and five type. The President, the War and Navy secretaries and the commander of the Air Transport Command, also the Air Priorities Section and the regional offices thereof, may cut through red tape and direct by telephone or telegram that a priority be granted. Normally requests are made to one of the regional control offices or direct to the Air Priorities Section of the Air Transport Command—whose address is Room 5317, Department of Commerce Building, telephone Executive 2460, Branch 1240, Washington, D. C.—by: Government departments or agencies having knowledge of the necessity for the air transportation requested; or by Army or Navy officers assigned as plant resident inspectors, engineers or representatives at production plants or on construction projects.

In the case of individuals and plants engaged in the war program at which no Army or Navy representative is assigned, however, requests for priority will normally be made through the Government department or agency in whose interest the travel or transportation is required. But in emergency the request may be made to the nearest regional control office or to the Air Priorities Section of the Air Transport Command.

A pilot on a ferrying mission may carry 100 pounds of baggage and other priority passengers a maximum of 40 pounds free. The priority certificate issued, the prospective passenger is directed to notify the air line without delay of the reservation desired, credentials are submitted and tickets issued. That is the entire procedure, aside from that involved in a mass of secondary regulations which the lines keep on file for inspection and guidance.

War conditions thus far have had varying effects on the different lines but their experience is common in a number of particulars. Most agree that the percentage of priority passengers is on the increase, and that it will tend further upward as more passengers learn the mechanics of the priorities system and discover in many instances that they are entitled to a preferred status.

Naturally the full impact of emergency travel demands has fallen on routes which serve the busiest industrial centers. Pennsylvania Central, serving Detroit, Cleveland, Akron, Youngstown, Pittsburgh, Washington and Norfolk on one route, Pittsburgh-Birmingham and way points on another, Detroit-Milwaukee and Pittsburgh-Buffalo on still others, has been carrying a larger percentage of strictly priority passengers than other domestic air carriers.

Even so there have been light traffic days, and in mid-summer it was relatively easy to ride one of Pennsylvania Central's planes into Washington on a weekend. Getting a seat out was another matter. The "no show" passenger has been virtually eliminated.

On American Airlines, like the others, traffic has been heavy but spotty, varying with cities, destinations, routes and specific flights. The chances for the non-priority passenger were declared in general to be good, with only one chance in 20 of being forced to undergo an interrupted trip. Like the other lines, American was operating only about half as many planes as before Pearl Harbor, but carrying substantially more than half as many passengers. Aside from heavier loads, an explanation was the replacing of American Airlines' 14-passenger transcontinental sleeper planes with 21-passenger liners.

Eastern Air Lines, running a score of busy planes between New York, Washington, Florida, Chicago and as far west as Brownsville, Tex., reported plenty of chances for non-priority travel remaining, even though it was difficult to count on a particular schedule. These reports in general cover the experiences of United, Transcontinental and Western Air and most of the rest.

In the light of conditions as they have worked out thus far, there seems no logical reason therefore why anybody should hesitate to travel by air now any more than a year ago—provided there is room for him. One can enjoy the satisfaction of knowing that, because of priorities, he will not displace anybody who is entitled to a seat due to his being on urgent war business.

END

## Vertigo

(*Continued from page 52*)

instrument flying, as well as to the physiological reactions that result from sensory illusions.

Of course, we don't balance with only one set of senses. We see, we feel with the skin, muscles and joints. But the organs of equilibrium located in the inner ear are by far most important, especially the canals just mentioned, because they are so constructed as to give incorrect sensations under certain conditions. For example, a turn under the hood may begin without the pilot knowing it, but when he stops the turn it feels as if he were still turning.

The reason is easily explained by reference to Figures 2 and 3. When the head is rotated, the fluid in the canal in Figure 2 moves, which in turn moves the fine hairs illustrated in Figure 3. This stimulates the nerves which transmit a signal to the brain, and we feel that we are turning. Now if the speed of rotation is low or if the rate of turn is low, we might not feel the turn begin, because the motion was imperceptible. Thus the pilot on instruments can enter a turn without being aware of it. This might have happened to Captain X.

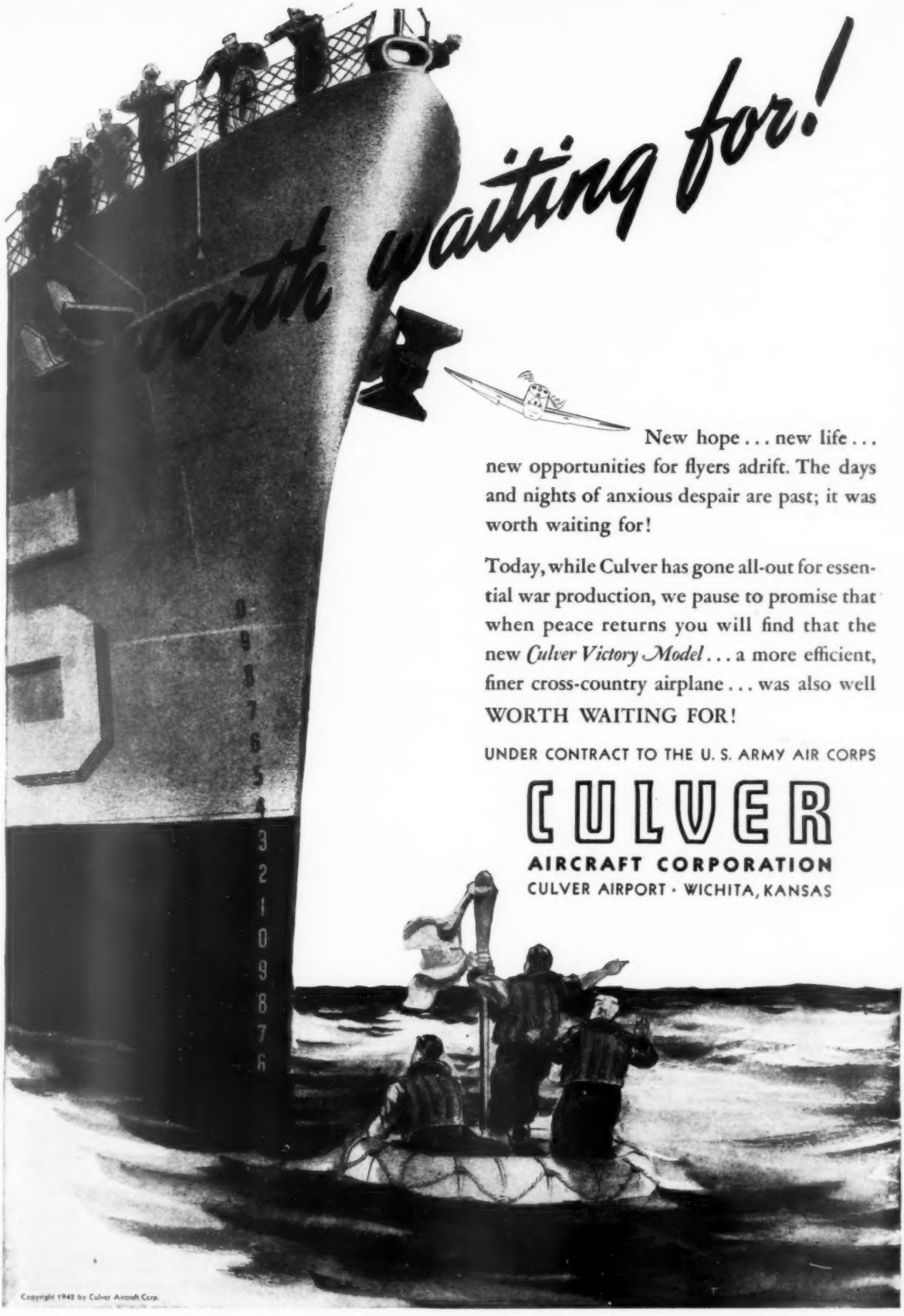
Now should the pilot glance at his instruments and find he is in a turn, and should be correct his position and stop the turn, the fluid in the canals would continue to move due to momentum. In this case the fine hairs would give a signal similar to a turn, and the pilot would be led to believe that he *was still turning.* This might cause him to correct still farther, which might lead to a crash or a spin from the clouds—an event that has been far from unusual.

There are additional factors in the sensory illusions that also complicate the picture, and may have led to the crash of Captain X. For instance, in a steep turn, the force or "G's" depends upon the angle of bank, not upon speed. The phenomenon has been explained previously in FLYING and will not be gone into farther at this time. However, this is also important: a needle-width turn, on instruments, is not always made with the same bank. That is, at 150 m.p.h. the bank would be 20°, while at 300 m.p.h. it would be 34½°. That means that an instrument pilot would be subject to different G's according to varying conditions.

Suppose, then, that the sense of touch (skin) and feel (deep muscle) is added to the picture of balance and equilibrium. In normal flight 1G is felt, while in a 60° bank 2G's are experienced. Also, under conditions of climb or acceleration, additional G's exist. That means that a pilot on instruments will feel a pronounced sensation of climb when he enters a steep bank, and in response to this sensation the pilot *will tend to push the controls forward and end up in a tight spiral.*

Pilots who trust their flying sense, so-called, instead of relying on their instruments, will usually tend to underrate the steepness of turns. That will mean that when they recover to normal flight, the removal of the strain of excess G's will lead to a feeling of less than normal weight and may produce the sensation that the airplane is falling. This feeling may be so marked that only by concentrating on the instruments and by cold, logical thinking will the pilot be able to refrain from pulling back on the controls, stalling the plane, and spinning in.

As most pilots know, the angle of bank in a perfect (ball-in-the-center) turn cannot de detected. The lightplane pilot, who is rash enough to venture into instrument weather or clouds, should know these things. Moreover, he should be able to use the simple method of flying given in the last few paragraphs of this article. While it is *not* intended as something for novices to practice, it is felt that it might help avert the crashes we read about following sieges of bad visibility.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Bad visibility, and the lack of vision as a helping sensation, brings about disturbing sensations. How much we depend upon our eyes at all times is brought out in the following most interesting experiment, called the "Witches' House," sometimes found at pleasure resorts:

In the experiment the subjects are seated inside a room; the chairs are in reality the bottom of a pendulum, which oscillates. Unknown to the subjects, the walls are moveable, and can be rotated 360°. When the pendulum is moved, the subjects feel the movement, but in a moment the pendulum is *stopped* and the walls begin to move. In a few minutes the motion increases, the subjects grasp their chairs in fright, until finally the walls make a complete revolution—or perhaps half a revolution, stopping in a vertical position.

The subjects, seated in their chairs, believe themselves to be upside down, hang on desperately, and often faint, vomit, or collapse. (The moral of it points quite clearly to what may happen when one is under the hood or actually on instruments: unless we rely absolutely on the instruments, our sensations can do us great harm).

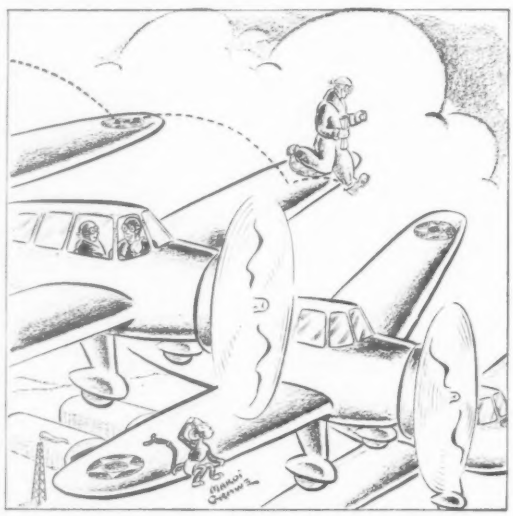
Another example of this is in the phenomenon referred to as the "leans." It is most disturbing, and produces the illusion of turning about any or all of the three axes of the airplane. Some pilots, after looking behind them quickly, swear that the instrument panel made a complete revolution as they watched it. These illusions are not often lasting, and while no known cure exists, the knowledge that they do happen should be sufficient to put pilots on their mettle.

There are still other forms of vertigo. One occurred not long ago when a pilot, flying formation at night, followed his leader from a lighted portion of the sky to a dim, horizonless part. Although the pilot could have gone on instruments, in reality his only job lay in the following of his leader. Instead he permitted his sense to overcome his trust in the leader, and the feeling that he was approaching a stall was too much for him. His normal reaction was to recover from the attitude, which he did by pushing forward violently on the stick. The result was an outside loop, from which the pilot was fortunately able to recover before striking the water below.

The point of this entire discussion about vertigo is that pilots must be on guard against false impressions, and should be advised what to expect or how to counteract them. When such conditions develop it is a fatal mistake to look for the horizon or to fly by "sense of feel." Although the hope has been raised that we may, some day in the far future, develop our senses and fly entirely by feel, this is too fatuous to be true. Birds have been known to "spin in" during conditions of bad visibility, and certainly if they haven't developed "flight by sense" we have little hope to.

The application of the above to private flying and lightplanes is simply that one must avoid conditions of instrument flying unless one is qualified and in constant practice, and second, that the pilot must be aware of symptoms of vertigo. An analysis of recent crashes in which vertigo may have been a contributory cause discloses that the greater number occurred during periods of reduced visibility rather than during zero visibility. This is believed to be due to the fact that during zero visibility conditions, pilots are definitely flying on instruments whereas in reduced visibility they are changing back and forth, and thereby carrying over their "flying by feel" to the instruments, and thence becoming involved by false sensory illusions.

Again, a number of crashes have occurred as the result of pilots deliberately flying into relatively small clouds. They were seen to come out of the cloud in a spin and to crash before recovery could be made. It must be admitted however, that turbulent air, updrafts and other circumstances could have caused the spin, but it is also evident that the sudden shift from contact to instrument flight, with the sensory carryover, could cause vertigo.



"Looks like the skipper's radio is acting up again. There goes his stooge with a message."

Pilots are, as a rule, more subject to vertigo when nervous, tired or tense. Conditions of poor health—colds in the head, congestion in the inner ear, constipation, and alcoholism—can contribute to vertigo. There is no doubt that flying, because of its very nature involving strenuous forces, increased G's, altitude change, and demands for clear thinking and clear sensory perceptions, will always be limited in the extent to which it may become general. The exception of course is slow, safe craft flown only under ideal conditions—but to many of us that is not flying.

Practically, one way to avoid crashes in private flying under conditions of poor visibility is to close the hangar doors. If one is rash enough to venture forth and gets caught, here is a suggested procedure. It is *not* a prescribed method, but merely a life buoy, something to turn to in case of emergency. Don't make the mistake of thinking you can fly by "feel" instead of by instruments, because the diagrams accompanying this article prove that you cannot. There is only one way to fly "blind"—and that is with instruments.

As instruments are so costly that there is hardly a lowpower plane in the country equipped with gyro horizon, gyro compass and a turn indicator, some method of flying out of fog should be presented. Here is one method that has been tried and proved useful; use it *only* to save yourself—don't be so rash as to fly into a cloud and practice it. Let's suppose then that the emergency has arisen and for some unforeseen reason you're unable to see the ground, sky, or horizon. Here's what to do:

1. Relax completely, both mentally and physically.
2. Don't—whatever you do—try to fly by feel. Remember that you can feel like you're turning when you're not, and vice versa.
3. Get on an east-west compass heading and hold it. (The reason for that is the lack of turning error; learn something about a compass and the way it acts when the plane goes into or recovers from a turn.)
4. Fly your course by using the rudder alone. Presumably your plane is rigged reasonably well and, if so, the rudder will keep the plane headed straight, wings level. You will skid some to effect this.
5. Maintain level flight by means of the airspeed indicator, the tachometer (r.p.m.) and the altimeter. Adjust the stabilizer so the plane flies level with hands off the stick. This will keep you from "spinning in."
6. Get out of the overcast as soon as you can. The best way is to let down by removing some throttle and holding the airspeed constant by slight stabilizer adjustment. It is dangerous to try to turn (although it can be done) because the odds are against you; there is no way to estimate either the amount of bank or the rate of turn, and the effects of vertigo after stopping the turn might be so confusing as to result in over-controlling and entering a spin. If it is impossible to let down because of obstructions ahead or absolute zero-zero visibility, attempt a turn using rudder alone for just a few degrees at a time; this will avoid the possibility of vertigo, excessively steep banks, or erratic compass behavior.

END

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# The Zero

(Continued from page 26)

from the Southwest Pacific, many erroneous impressions about the plane gained currency. One of the most widespread was that the Japs had slipped one over on the occidental world by building a plane chiefly of plastics and plywood—while we still were talking about doing it.

Most of the fallacies have been disproved by this time as a result of careful examination of the wreckage of Zeros shot down in various combat zones. Complete performance data, of course, will not be available to our engineers until at least one of the Zeros is flown and tested thoroughly by an American pilot. This may not be long in coming, however, for one of the planes was captured virtually intact in Alaska recently. It was promptly crated and sent on its way to Wright Field or another of our aeronautical laboratories.

In the meantime, let's piece together a picture of the plane from the facts already known.

There's nothing mysterious about the Zero, actually. To build it the Japs pulled nothing out of the hat. They merely sacrificed certain characteristics which we, the British *and the Germans* long ago decided were indispensable to military aircraft. Chief among these are armor protection for the pilot and self-sealing gasoline tanks.

The Zero—it is called that because Jap planes are designated by the final digit of the year in which they go into service, which was 1940, in the case of the Zero (or the year 2600, in the Japanese calendar) is a single-seater, low-wing monoplane. Its fuselage is a good quality of duralumin, although thinner than that used for American planes. An interesting feature of the fuselage design is that the wings and fuselage are in one piece. This means that there is no interchangeability of damaged wings in the case of the Zero. If a wing-tip is damaged, for instance, there's no such thing as slapping a new wing into its place. The whole fuselage of the Zero must be discarded.

Use of the one-piece design has the advantage of weighing less than the demountable wing type and it also can be manufactured faster. The weight factor probably was controlling in the Japs' decision to use the one-piece type because it contributed directly to the attainment of the two characteristics at which they evidently were aiming—climb and maneuverability.

Lieut. Col. Boyd (Buzz) Wagner, one of the leading American combat pilots in Australia, had this to say of the Zero:

"It's not a wonder plane, but it has the respect of all our pilots."

Colonel Wagner praised particularly the Zero's "beautiful landing gear," which folds completely up into the fuselage, and the fact that the latter is flush-riveted throughout, thus making for very few protuberances which would create wind resistance.

The fly in the ointment—the hole in the Zero, so to speak—is its structural weakness and lack of protection for the pilot and gas tanks. American flyers repeatedly have found that a burst of .50 caliber fire will break the back of any Zero if it hits just behind the wings. It causes the fuselage to crumple at that point. On the other hand, American fighter planes consistently get back to their bases or carriers even though riddled with Jap machine gun and cannon fire. In that connection, it is pretty generally agreed that the Zero's inferior firepower is another of its major weaknesses.

Instead of the heavier .50 caliber machine guns upon which American airmen place their greatest dependence, the Japs use two 20 mm. cannon, mounted one in each wing, and a pair of 7.7 mm machine guns, mounted in grooves atop the engine cowling and synchronized to fire through the propeller. That system is a holdover from World War I and had been discarded by most other air forces a long time ago, primarily because synchronization of fire with the propeller necessarily slows down the rate of fire.

The cannon used in the Zero is probably the Swiss Oerlikon gun, which both we and the British belatedly decided to adopt after it was found that the Nazis were wrecking British planes with a similar weapon. An ironical thing about this particular gun is that it was offered to the United States Army and Navy as far back as 1927—but they weren't interested, so the salesman went on to Japan where he had better luck!

Like the U. S. Navy's carrier-based fighter planes, the Zero is powered by a radial engine—a twin-row, 14-cylinder job which is very similar to a well-known American engine. It is somewhat less powerful, however, probably turning up between 950 and 1,000 h.p.

The plane weighs between 4,500 and 5,100 pounds loaded and at normal flying weight it can do about 315 m.p.h. at 10,000 feet altitude. It has a service ceiling, however, of about 36,000 feet.

"They can go up like an express elevator," one American pilot said, almost wistfully, "and can turn on a thin dime."

The Mitsubishi company, one of Japan's largest manufacturing concerns, is credited with the Zero's development.

Many an American pilot, out-maneuvered by the Zeros, has returned to his base angrily declaiming about what he could do to those so-and-so's if he just had a plane that would perform like theirs. When air intelligence officers try to find out from those same pilots, however, just what they would be willing to sacrifice from their own planes to attain those characteristics, the answer is almost invariably "not a thing." They all want the security of the armored seats and head rests, the self-sealing gasoline tanks that preserve precious fuel supplies even after being riddled with as many as 100 machine gun bullets. They all want their good two-way radio sets and their all-important navigation instruments. Even the Japs recognized the need for the latter and their Zeros have good instrument panels—nothing unnecessary but nothing vital left out.

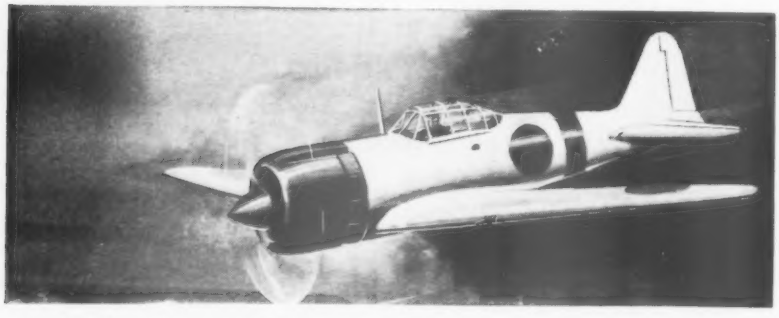
Oh, yes, the Zero is a doughty fighter, one not to be sneered at, but just to document the Navy's contention that it is by no means invincible, consider the battle record of Fighting Squadron 3, attached to the U. S. aircraft carrier *Yorktown*. In four separate actions, three on the same day, during the Coral Sea and Midway battles, Squadron 3 bagged a record total of 54 Jap planes and probably downed 18 others in what the Navy called "the most decisive series of individual aircraft actions in the war to date."

Of the total, at least 22 of the Jap planes destroyed were Zeros. On the other hand, only two of Squadron 3's planes were shot down. Two others were lost at sea after running out of gas.

In its first brush with the enemy in the Coral Sea battle, Squadron 3, its pilots flying the Grumman *Wildcat*, shot down a total of 28 Jap planes, of which 14 were Zeros. No U. S. planes were shot down in that action but it was after that fight that two of the American planes were forced down at sea for lack of fuel.

A few weeks later, when the Japs launched their powerful invasion thrust at Midway Island, Squadron 3 took the air on three separate occasions on June 4. Under command of Lieut. Comm. John S. Thach, they roared off the *Yorktown's* flight deck to escort a squadron of torpedo planes bound for the enemy's fleet. En route, they were attacked by a formation of 20 of the deadly Zeros but when the shooting ended, the score was: Eight Jap fighters (Zeros) positively shot down and several others probably destroyed, as against two U. S. fighters lost.

Later in the battle, when the Japs were



Artist's sketch, based on photos of crashed Zeros, shows trim lines of that Jap fighter.

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dive-bombing the *Yorktown* with 18 dive-bombers protected by a similar number of Zeros, fighter combat patrols from Squadron 3 intercepted the attack and broke it up so completely that only four of the enemy planes were able to drop bombs.

In the squadron's third action that day, another attack on the *Yorktown* by 18 torpedo planes, each with a Zero escort, was hit so hard that only five enemy planes broke through.

More specific details on the results of those individual air battles have not yet been released but the Navy said it was definitely known that on June 4, Squadron 3 shot down a total of 26 enemy planes and probably downed 11 others.

The fact that only two of its planes were destroyed in three separate engagements, each time against superior numbers, demonstrates rather conclusively that Squadron 3's pilots were more than a match for the vaunted Zeros. Most Navy men say the superior training given our pilots is largely responsible for such brilliant showings as Squadron 3 made against the enemy, even when the latter's weapons are superior in some respects.

Nor are victories over the Zeros confined to Navy flyers.

Correspondents attached to Gen. Douglas MacArthur's headquarters in Australia reported recently that in one month, Allied airmen in that theater shot down 61 Jap planes, all but seven of them being the highly touted Zeros. In the same period, the American, Australian and other United Nations flyers lost only five of their own fighters and eight bombers.

The 61 Jap planes listed as shot down do not include those "probably destroyed" or those destroyed on the ground in attacks on Jap airfields. Many of the former doubtless will never fly again because of their structural fragility.

In discussing this particular demonstration of Allied superiority over Jap airmen, a United Press correspondent attributed it to a number of factors:

"1. Increased experience of Allied pilots who have overcome the disadvantage of fighting against Japanese airmen who were seasoned in the China war.

"2. Improved tailing tactics and formation interception which concentrates fire power of the Allied planes and enables Allied pilots to cover each other during the battle.

"3. Improving planes available here to overcome minor weaknesses and adapt them to conditions in this theater."

He told of pilots at one base, for instance, experimenting with hooking a *Flying Fortress* engine on a Douglas A-24 single-engined scout plane and dive bomber. Although the result was an over-powered plane which was a nose-heavy "maverick," the flyers learned something from the experiment.

The encouraging thing about reports of Army and Navy victories in the air is that if the Allied flyers, using admittedly inferior planes — Grumman *Wildcats*, Curtiss P-40's or Bell *Airacobras*—can achieve such results, what can we expect when such new battleplanes as Republic's mighty P-47 *Thunderbolt*, with its 2,000 h.p. radial engine which enables it to outperform the Zero at top altitudes and at speeds in excess of 400 m.p.h., reach our combat squadrons in large numbers?

With those and other equally good planes going into service, it is easy to understand the Navy analyst's meaning when he said:

"All we hope is that the Japs will just keep on building Zeros!"

END

## "Report from London"

(*Continued from page* 29)

direction is a cause of inaccuracy. If the extreme case is taken of a dive bomber diving absolutely vertical in still air the bombardier would not need to aim off from his target on the ground or to make any calculations whatever. He would simply aim and sight straight down. The dive bomber does not normally attain a vertical dive (though the theory that it cannot do so is by no means proved). But the closer the aircraft is to the vertical the more nearly is the bomb sent off in the direction of the target and therefore the greater the accuracy.

Dive bombing was devised as a method of close-range bombing. Close range gives accuracy for many obvious reasons. The level bomber can launch its bomb at close range. If, for example, the dive bomber releases its load at 1,500 feet the level bomber could do the same. But the flight of the two bombs would be totally different and the bomb from the level bomber would be inclined to "bounce" if it were of the delayed action type. If it were not of the delayed action type it would probably throw up fragments which would damage the aircraft. This bouncing is a very real trouble in low-level bombing. But it does not happen with the dive bomber because the bomb is flung directly at the target and does not strike it at a flat angle.

The fifth and final point is that the bomb is given additional impulse in the direction of the target. When the target is a very well protected one, it is of value if the bomb can be given as high a speed as possible, because the penetrative powers of the bomb go up with the speed. There are two ways of giving the bomb speed: by launching it from an enormous height or by launching it in the dive. If the bomb can be launched from 30,000 feet it will acquire a greater speed than it can be given by a dive bomber working at 2,000 or 3,000 feet, but the height means that the target cannot be clearly seen and that many aiming errors come into the picture. Therefore dive bombing should always be compared with low-level bombing. In this case it has an advantage in penetration. If the dive bombing aircraft is dived at 250 m.p.h., which is the approximate rate the German dive bombers attain with air brakes in full operation, then the bomb is given an additional impulse in the direction of the target of 250 m.p.h. and this is in the proportion of at least one-third the speed the bomb would gain if dropped from a great height. It is therefore a useful addition to the bomb's speed. More modern dive bombers than the Germans use, with really sound air brakes, should be capable of making their dives at higher speeds while retaining full control and the ability to flatten out without difficulty, but probably dive bombing speeds would not go much above 300 m.p.h.

These are the points about dive bombing which have not been widely understood in Great Britain. Many people in official positions have not understood them and that is why there has been in Parliament and outside it a good deal of muddled thinking about the dive bomber. It is perfectly true that the dive bomber is highly vulnerable to fighters—but so are all low-level bombing aircraft. Fighters must clear a way for any kind of close support bombing and if they succeed in clearing a way the dive bomber is as secure as other types.

At the time that these notes are being prepared United States dive bombers are coming into service in the Royal Air Force, though they have still not been reported in action. But there have been rumors that they will be converted to other uses. If I may express a personal opinion I would say that any such conversion would be a mistake. These aircraft were originally designed for dive bombing. They have air brakes of approved pattern and they could be extremely useful as dive bombers.

* * *

After dive bombers the subject that has probably been most in the minds of those concerned in British service aviation is that of the new fighters. The Focke-Wulf Fw-190 has for some time been in the hands of the technical department of the Air Ministry and has been thoroughly examined and its performance noted. It is regarded by Air Force pilots as an extremely good machine. Its performance is excellent with the top speed of 375 m.p.h. at 18,000 feet and a rate of climb at height of well over 3,000 feet per minute. The BMW-801 engine in particular has attracted widespread praise mainly on account of the fan cooling and the sliding ring in the nose which enables air flow around the cylinders to be adjusted. This engine will repay close study by engine makers. It is obviously a fine piece of work.

The aircraft itself is an all-electric machine with a high degree of automaticity. Undercarriage retraction, the working of the wing flaps, the engine controls and other items are interlinked in an ingenious manner so as to reduce the separate functions necessary to be done by the pilot.

The aircraft's armament of four 20 mm. cannon and two machine guns is not particularly advanced, except that it is the first time that cannon have been synchronized to fire through the disc swept by the airscrew blades.

It has been known for some time and

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the fact was confirmed by Colonel Llewellin, Minister of Aircraft Production, that a new machine is coming forward which is superior to the new types of the enemy and there is a reasoned confidence that these new machines will give Royal Air Force fighter pilots another slight technical lead over the enemy.

One of the new types is the Hawker *Typhoon* with Napier *Sabre* engine. It has been expected in service for more than a year and the delay has caused some slight disappointment here and there. But most people who are familiar with the problems of putting a new aircraft into service were less inclined to believe that this machine would go through all the development stages with the rapidity that was at first expected. They were not therefore so disappointed when delays occurred and this is especially so in that the Napier *Sabre* engine is a revolutionary type of power unit showing a greater compactness for its power than any other existing aero engine. It is, as readers of FLYING will know, a 24-cylinder H-type engine with two crankshafts geared together at the main shaft. It was designed by Maj. F. B. Halford.

It is a "box of tricks" with everything packed in so closely that there is no free space left. But if it can be made to work well this engine might easily prove to be the outstanding technical feat of the entire air war, for its possibilities of development are very great and the announced horsepower of 2,000 is obviously a conservative preliminary figure which we may expect to see greatly stepped up in the future. The *Typhoon* therefore may prove a good competitor for the Focke-Wulf Fw-190.

So once again we have the position that the time factor is the deciding one. It will be a question of whether the enemy manage to get the Fw-190 into service in greater numbers than our newer machines when the next big flare-up in the air war occurs. Some *Spitfires* now carry increased armament, in the shape of four cannon.

Everybody in the Royal Air Force is interested to see how the Republic *Thunderbolt* will behave, for in this machine it is possible that the Focke-Wulf may meet its master. However, there is very little information available in Britain about the *Thunderbolt* and only very general figures have been published here.

* * *

During the cloudy days of July and August the Royal Air Force made a large number of daylight raids on Germany itself. Nearly all these raids were made with the aid of cloud cover, for it is not considered practical to send bombers for great distances over enemy-held country in the daylight without such cover. Only in very special cases such as the Augsburg raid by Avro *Lancasters* and the raid on Danzig (also by *Lancasters*) is it thought worth while to take the risks of heavy losses which are entailed in daylight bombing operations.

But by utilizing cloud cover the Royal Air Force Bomber Command has been able to send over aircraft such as the Vickers-Armstrongs *Wellington* and to find targets in Germany and bomb them without great risk of loss. The Germans have done the same kind of thing against England and have sent bombers over in the daylight using cloud cover, but they have not done it to quite such a large extent as the Royal Air Force. These raids are merely intended to maintain the pressure of the night raids. They are never made on a large scale for the mere fact of the use of cloud cover precludes this.

But the whole question of the use of daylight raiding is resurrected by these raids. It is still held here as it always has been that for precision bombing the daylight is necessary. At night the use of dummy fires and of decoy camouflage is now so ingenious that the most skilful pilots are apt to be misled and to waste their bombs. Only the mass bombing of the kind employed by Air Marshal Harris can be entirely effective for night work. For the hitting of a precise target such as a particular factory or some specified harbor equipment the daylight must be used and the question has exercised many minds of when and how the Royal Air Force will be able to bomb Germany in the daylight, in force and without the use of cloud cover. Here again opinions are divided but there is a fairly general agreement that only two methods are possible. One is to use high-flying machines, and the other is the use of fast-flying machines. If medium bombers can be produced capable of speeds of 350 m.p.h. they would stand a good chance of raiding Germany in daylight without suffering heavy losses.

It is instructive to notice that the Douglas *Boston* bombers which are among the fastest bombing aircraft in the Royal Air Force have suffered very small casualties during their raids on occupied France. It is true these raids are comparatively short-range affairs, but they are done in broad daylight sometimes without fighter cover and they do testify to the value of high speed. As for high altitude work this depends upon the turbosupercharger, a thing which the United States have developed further than most other peoples. But the turbosupercharger is not the only need for high flying, as we all know now numerous other factors have to be considered and the problem of keeping the crew alive and efficient at great heights is still not entirely solved. But in the eventual crushing of Germany it is generally believed that the night bombing must not only be intensified so that raids on the scale of the thousand-plus Cologne raid of the 31st of May are frequent, but also that they must be supplemented by daylight raids by strong medium and heavy forces.

END

## Powered by Hot Air

(*Continued from page 50*)

sure will be exerted from within on every square inch of the surface of the cube—the principle of the hydraulic press. Now suppose a one inch square hole is cut out of that surface. Then, on the opposite side of the cube, the square inch directly across from this hole would bear an unbalanced pressure of 10 pounds tending to move the cube in the direction of the pressure. Inflate a toy balloon and release it without first having fastened the neck and you'll have a parlor demonstration of jet propulsion. Radiator tunnels on liquid-cooled engines can function like jets and can cause a slight additional thrust. The speed of the airplane rams the air under pressure through the radiator where it is heated and expanded rapidly in passing—all the elements of jet propulsion!

Although the Italians use a motor-driven compressor and Junkers is using a multibank two-stroke radial in their experiments, the ideal would be a rotary compressor and a gas turbine on a common shaft. Ask an engineer how he'd design an engine for jet propulsion only and you'll get a novel line of thought. First, he'd dispense with the crankshaft, since there is no propeller. Without a crankshaft there would be no need for a piston. So, why not eliminate the exhaust valve and make firing continuous so that a steady jet of burned and expanding gases would be blown out the open cylinder bottom? All that remains after this is to alter the shape of the cylinder as a combustion chamber and narrow the bottom opening into a properly shaped jet for efficiency. In the case of the rocket motor in which the fuel would be carried in the cylinder or combustion chamber, even the intake valve would be eliminated. Jet development actually follows this line of thought. In 1908, Lorin, in France, placed a conventional six-cylinder engine flat on its side and installed six long tapering tubes in the cylinder heads so that the explosions within the cylinders blasted right out through the open tubes to create a crude form of jet. Current jet ideas have been evolved as outlined above and conceive batteries of single combustion chambers arranged in circles to fire through one jet tube.

European engineers picture the ideal jet-propelled ship as having a pressurized egg-shaped cabin nose section for the crew. This "egg" would fit into the open end of the fuselage proper so that a circular opening would ring the fuselage at the junction of the front and rear sections. The high pressure boundary layer of air would rush through this opening to the compressor amidships. This compressor, incidentally, could be made to heat and pressurize the cabin. Jet adherents say that ultimately such powerplants will prove relatively cheap, small, and of a convenient shape for small fuselage cross section area and that a more powerful thrust for weight ratio will result in speeds beyond present engines. Lack of a propeller obviates a long landing gear for prop clearance.

The schemes discussed thus far obviously involve using most of the internal fuselage space for the compressor-power-

(*Continued on page 99*)

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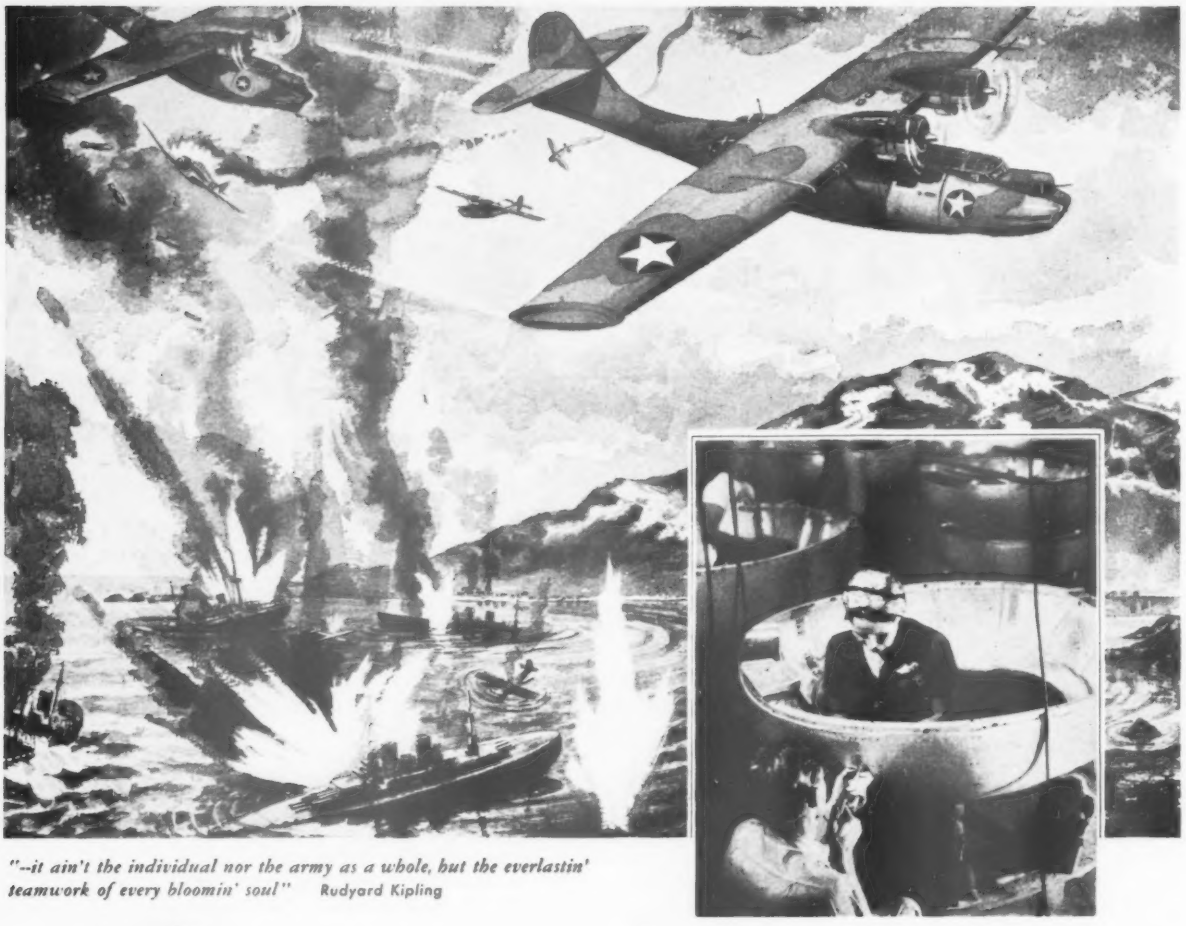

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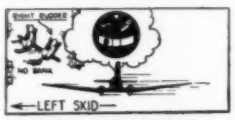


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(*Continued from page* 94)

plant and the jet tunnel. However, some designers are looking beyond this. N. Schurter of Zurich, Switzerland, envisions a conduit along the leading edge of the wing with rearward pointed jets from the semi-chord point on the bottom of the wing. Schurter's design would serve as a deicer since the air within the conduit would be at an elevated temperature. F. Whittle, in England, sees blower type rotary compressors, the rotor bearing and the compressor being liquid cooled. Other designers would install the motor-driven compressors in nacelles or within wings in orthodox multiengined arrangements.

The U. S. Army Air Corps became interested in jet propulsion as long back as 1923 and even before that in 1909 that incredible inventor, Lake, had worked with the jet idea. In 1923 the U. S. Bureau of Standards, on behalf of the Engineering Division of the Air Service, submitted to the NACA the findings of one Edgar Buckingham who had been doing research on the subject of jet propulsion. Buckingham found jets inferior to propellers (jets and propellers are only different ways of obtaining a propulsive reaction from an accelerated stream of air) because the jet combined small mass with high velocity, whereas the ideal is large mass at a lower velocity. Since the required kinetic energy input increases as the square as velocity goes up it is apparent that low velocities require less energy input in proportion. Jets are most efficient when their speed jibes with that of the ship itself. When Buckingham made his tests the highest speeds then conceivable were in the neighborhood of 250 m.p.h. and it was on that basis that he made his computations. At that speed he figured the flying squirt would require four times as much fuel per thrust horsepower as the conventional engine and airscrew.

Though Buckingham knew that the picture would improve steadily as speeds climbed toward the speed of sound—fuel consumption and the weight of the power plant per thrust horsepower would be less at such speeds—he could not have been expected to know that less than 20 years later, designers would be talking in matter-of-fact tones of super sonic airplanes. With technical developments of his day as a guide it was Buckingham who stated that a jet temperature of 2,500° and a jet speed of a mile per second would be required for take-off. By stepping up the volume of air expelled the Italians have cut those temperatures and speeds enormously, at least that is indicated by jet take-offs.

Yet other countries persisted to perfect the jet and in 1933 the NACA reopened the question and supplied funds to the Bureau of Standards for further tests and research. This time G. B. Schubauer substantiated Buckingham in the main but at the same time indicated what had to be done to make the jet a workable proposition. He said that if the thrust of the jet could be augmented without requiring greater horsepower, then the jet could compete with the propeller. That ancient and long tantalizing dream of the simple jet for motive power could be realized only if the jet could be further augmented to step up its thrust to practical quantities. Engineers knew generally what had to be done but the Italians with the Caproni-Campini were the first to ring the bell.

Crux of the jet propulsion problem is the necessity of reducing the disturbance between the rapidly moving expelled jet and the surrounding air. The resulting friction tends to hold down the speed of the jet, building up back pressure in the expansion tunnel just as a muffler creates back pressure in conventional engines. Schubauer calculated that at 100 m.p.h. only eight per cent of the kinetic energy of the jet was being converted into thrust.

Most effective recent developments pass the jet of air through a Venturi tube or a series of Venturis arranged in such a way that the mouth of each Venturi fits over the open rear end of the Venturi in front. By making each Venturi larger than the one before the effect is the same as having one tapering tube with opening running ringlike around the tube at regular stations—only the Venturi shape imparts added efficiency. In these setups the air outside of the Venturis is sucked in through the openings and is entrained with the air jet to increase its mass. Added mass means added efficiency. Another interesting factor is that the jet can be made to improve the aerodynamic effect.

In a sense the fuel for the jet ship is really the air itself. It's a fuel available anywhere and it doesn't raise the wing loading a bit. The small amount of the usual fuel necessary to drive the compressor engine or engines means terrific range once the jet jobs are perfected. Intercontinental raids by swift engineless bombers—engineless as we now know them—may become fact instead of fancy.

Writing in the authoritative English aero journal, Flight, G. Geoffrey Smith summarized advantages of the jet propelled ships. To cite the more important ones, in effect: fuel might be paraffin, powdered coal, diesel oil, tar oils, gasoline or almost any other fuel giving high heat; direct application of power without transmission or conversion. The compressor system can be made to heat and pressurize the cabin; rotary engines would be smaller and lighter than reciprocating engines and would have a superior power to weight ratio; planes would be of "lower build" since propeller clearance would be unnecessary. They would have better form drag, nose free for pilot and armament, improved maneuverability because the jet orifice can be swivelled for powerful control effect.

All these features would give freer rein to designing those dream ships of the future. Visitors to the Paris air show in 1938 saw an interesting model depicting the French conception of a jet-propelled airplane of the near future. The project was for a midwing monoplane of 14,000 h.p., having a speed of 1,000 kilometers an hour and a ceiling of 30 kilometers. No doubt the French were optimistic and impractical but they were only being cognizant of current research in the jet field.

# Manta

(Continued from page 54)

estimates, based on wind tunnel performances, is to fly faster than 400 m.p.h. and, with a 17-pound per square foot wing-loading, land at less than 60 m.p.h.! But this isn't all it will do. The capabilities, hereafter outlined, are based on the testing of three models of the plane in the wind tunnels of the University of Washington and the California Institute of Technology.

The plane, fully loaded and armored, with four heavy machine guns and four shell-firing cannon, with plenty of ammunition, will act as a long-range fighter or as a bomber convoy, capable of flying 3,500 miles non-stop. We don't have ships like that today—fighter convoy planes which will ride with a bomber over that distance.

Technically, it is mid-wing monoplane. Its guns are so mounted in mock-up that they are directly on the line of flight. As every combat pilot knows, low-winged jobs have a tendency to nose down when the guns are fired, and high-winged jobs to nose up, thus destroying the aim of the gunner after the burst is fired.

Davis says: "The guns in the Manta are aimed on the line of flight and there will be no nosing up or nosing down. Furthermore, the guns, set completely into the wings, can be kept at usable temperature under all conditions. They are out of the slipstream and outside of the propeller disc, so there is no problem of synchronization."

Today, the Manta has been designed, has passed through the mock-up stage and has undergone stress analysis. The 50-foot mock-up will be powered by any 1,150 h.p. motor, which at this stage of the game is the Allison.

"You lost 500 planes by not being alert! Now, by Gad, you'll stay in there 'til you say you're sorry!"

"We went at the job of building the Manta absolutely backwards," Davis declares. "We built a shell first. Then we put in the needed parts, making sure that they were inside, where they would produce no drag of any kind. Then we built our structure around them. The tendency of older designs has been to build the airplane and then try to find spots for guns, ammunition and other equipment, with considerable drag resulting."

Another thing of which the Manta can boast is that all changeable loads are carried at the center of gravity. Davis, expert on aerodynamics, points out that shifting loads, resulting in a plane going out of trim, cause a great loss of operating efficiency through the drag of compensating control surfaces.

"The Manta is a simple airplane, simply designed. There will be no need of tabs or other correctional equipment," he says. "There is no need for such correction if a plane is properly designed. In a poorly designed ship, although it is 'clean,' there will sometimes be as much as 25 to 30 per cent increase in drag load of control surfaces. The faster the ship, the more pronounced is this drag."

Davis refers to pilot, gasoline, guns and ammunition when he speaks of changeable loads.

"American designers have been making one pretty bad mistake," he says. "It really is a series of mistakes. With a ready willingness to sacrifice true wing efficiency, they have cut the size of the wing to reduce drag and gain speed. They have put in more horsepower. They have increased wing-loading. And what has happened? Landing speeds have gone up in proportion. In order to reduce landing speeds, they depend on auxiliary gadgets, such as sliding flaps. If, in the beginning, sufficient attention had been given to proper correction of drag, the large flaps, which require considerable plumbing and add to drag, would not today be necessary."

Davis' Manta has split-type flaps.

If the Manta was being built in someone's backyard it would not merit too much attention. But with Davis' wing, it is something else again, much more important, due to the phenomenal success of the B-24.

While neither Davis nor Davies, who is also chairman of the management committee of Timm Aircraft Corporation, will discuss the attitude of the Air Forces toward the Manta, it is apparent that high-ranking officers have been most co-operative. Davies is a former war pilot, was once general sales manager of Curtiss Aeroplane and Motor Company, and is one of the best known men in aviation today.

One high Air Force officer told them that they had a tremendous airplane, asked them to make their mock-up. He said that they couldn't produce it within six months. Forty-five days later they asked for Army inspection. The Air Forces believes that the Manta has possibilities because of performance data submitted by Davis and Davies to that organization, and because of the reputations of both men.

"We've done the job bit by bit and piece by piece," Davis says. "We've had the money in the bank for each stage of our development before we've started on it. We've carefully budgeted every step of the way."

"The Manta design uses the patented Davis wing in one of its most efficient forms," Davies says. "It is the outgrowth of five years of experiments with propeller blades, working with controlled speeds from zero to beyond the speed of sound. The result is a high-lift, low-drag airfoil which behaves beautifully at low speeds as well as high speeds.

"Experiments have shown that the wing, as designed by Davis, has no wing-tip stall, apparently due to the fact that its tapering design is highly unconventional, with its patented wing-tips.

"The design which we now call the Manta was developed in an attempt by Davis and his associates to find the most efficient form in which the Davis wing could be applied practically. Wind tunnel tests were run over a period of two years before the highly useful design was fully worked out. The last test model we made looked like a big sting-ray, or Manta, in the tunnel. That's how the plane got its name.

"The design is well adapted for an entire series of airplanes, from light ships of low horsepower to huge cargo carriers. As a first ship to demonstrate the usefulness of the design we have mocked-up and stress-analysed a single-seater fighter with a 12-cylinder Allison, Rolls-Royce or Ford engine at the center of gravity, driving through a four and one-half foot extension shaft. The mock-up shows four cannon and four .50-caliber machine guns, with an adequate supply of ammunition for each weapon.

"There are various possibilities. As a night intercepter, carrying two hours' supply of fuel, we believe that this vicious fighter can climb 16,000 feet in four and one-half minutes, or to about 40,000 feet in 18 minutes. It is expected to have a top speed in excess of 430 m.p.h., and to be able to maneuver inside of anything of comparable speed now in the air. Empty of fuel and ammunition, it can land at 50 m.p.h. on its tricycle gear."

Davies' estimate of speed is believed to be below what the airplane can do.

"The plane has been carefully designed for mass production," he continues. "The leading edge and trailing edge of the wings are straight lines until they meet the detachable wingtip. Due to its 13-

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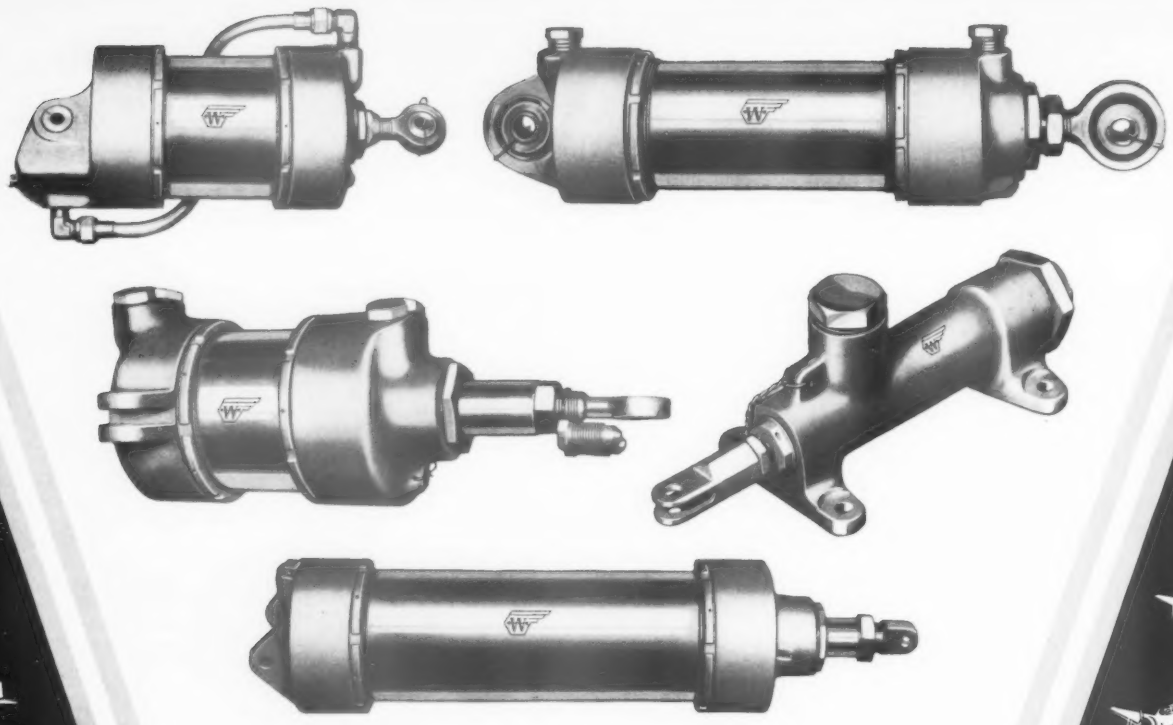

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foot chord at the root, the wing is thick, with plenty of room for controls, guns, ammunition and plumbing. The tremendous lifting power of the wing makes it possible to stow gasoline enough for 10 hours cruising, making it useful as a convoy for long-range bombers."

Davies also is looking to the post-war period. He declares:

"When the present feverish emergency has passed, it would seem that the aircraft companies which survive will be those possessing efficient designs which can be manufactured at low cost. Manta is such a design, protected by allowed design patents on the planform, and by license to use the Davis wing as its airfoil. Multiple engines may be completely embedded in the wings. The extended drive shaft would make possible the use of automobile engines without modification for light planes."

Credited with working on the Manta, in addition to Davis, is chief engineer William J. Waterhouse, once assistant chief engineer of Curtiss, Dayton-Wright and Douglas. He is credited with designing *The Spirit of St. Louis* and also worked on the Lockheed P-38.

Technically, the Manta has an aspect ratio of six to one, as compared to the Davis wing on the Consolidated B-24 with a ratio of 11 to one. It will have retractable landing wheels. With its range of 10 hours in fuel capacity, it will be able to fly 3,500 miles without refueling, enough to get it from New York City to Europe or from Los Angeles to Honolulu with plenty of gas to spare. In the latter case, when we get around to long bombing flights, it will really come in handy.

The plane is reported to have complete maneuverability at all speeds, to be free of tip-stall and, because of its generally balanced performance, to lower the possibility of pilot black-outs.

It can be made from practically anything, starting with plywood and ending with metal. It offers a chance to get away from aluminum, which may be necessary in ensuing months or years. And no matter what it's made from it'll go just as far, just as fast.

END

## Ontario's Forestry Flyers

(*Continued from page* 58)

If towers report smoke that is believed to be from a forest fire, the pilot who is sent out will be expected to bring in information as to the exact location, extent, in what kind of timber it is burning—good timber or slash (branches cut down), probabilities of its spreading, approximate velocity of wind, how close to water, easiest way to get in, how many men should be sent in, how many feet of hose needed and whether it is near a mine or other private property.

Equipment for an initial attack usually consists of two men and provisions for two days. The complement for the initial attack weighs 800 pounds, the payload of the type of plane usually used. The first load may include a pump and from several hundred to several thousand feet of hose. The hose, put up in 100-foot lengths, is of a special type that is not entirely watertight, therefore it "bleeds" and is kept from burning by being constantly wet. If the fire is only a few square yards in extent, the department may send a "wajack," (a container about the size of a milk can, with a hose), and shovels. A firefighter fills the "wajack" with water, puts it on his back and sprinkles.

"Get to the scene as quickly as possible," Ontario's sky rangers advise, observing that "if you let it get the size of a city block you have a man-sized job on your hands." Quick suppression, they demonstrate, is the essence of fire protection. Much forest fire fighting is done at night because there is less wind, therefore less danger to the men fighting the fire. Usually they can get at the side of a fire and "pinch it in," or drive it to water.

Ontario's forest fires frequently start in the "lightning belt," which begins at the Lake of the Woods and Red lake region, extends eastward across the northern shore of Lake Nipigon and of Long Lac, roughly to Sudbury, then southward to the North channel of Georgian bay and back along the shore of Lake Superior.

Lightning causes about 30 per cent of the fires in this area and such fires account for two-thirds of the damage done to timber. The balance of fires are due to carelessness. Lightning, which will always hit on the highest point, strikes dead trees on hills and splits them to thousands of flaming splinters that may be blown a quarter of a mile. Strong winds blow from the west, off Lake Superior, over areas where for 50 or 60 miles nothing can be seen but virgin pulpwood.

Fires started by tourists usually are not difficult to get at because tourists follow easily accessible watercourses. The place to kindle a fire is on a rock; tourists, however, frequently make fires on humus from generations of falling leaves and trees which may be four or five feet in depth. If a fire is hot enough for cooking, its heat will go downward and cause peat to smoulder two or three feet deep. The average tourist doesn't think to put enough water on it to soak the ground that deeply, yet such a fire may later come up 30 or 40 feet away. Because carelessness in the use of matches and cigarettes cause many fires, the government of Ontario insists that every tourist party have a permit (issued at no expense) and also take a qualified guide into bush country.

No burning may be done in Ontario without permission of the Province, but under certain conditions (chiefly in spring and fall) permits are issued to settlers to burn debris for clearing land. In the fall of 1938, after permits were issued, a period of dry weather came unexpectedly and settlers, particularly in the Fort Frances district, had to cut fire guards by taking out all trees in a strip wide enough to stop a forest fire. At Beardmore, east of Lake Nipigon, people were found dead without being burned because the oxygen was absorbed by the flames and they were suffocated. Many years ago a fire swept the entire town of Halebury in the Cobalt district and killed many people. A number of towns in the north woods—Geraldton, for example—have fire guards cut entirely around them.

One of the worst years for fire was 1936, when the government of Ontario had more than 4,000 men in the bush fighting fires almost all summer, besides using as many commercial planes as it could hire to supplement the air service. The government has authority to commandeer the services of anyone—including tourists—to fight fire.

Authorities believe that it is important for northern Ontario to be kept timbered to insure a general flow of water for hydro-electric purposes and to avert flood damage. In the Grand River and Thames River areas, where there are Ontario flood control projects, officials point out that spring snows cause floods because hillsides have been denuded of timber. Furthermore, fish and game are destroyed by forest fires which become so large that they raise the temperature of the water. Authorities state that one excellent trout lake in Ontario became so hot from a forest fire that rock was pulverized.

The forestry air service, besides keeping watch over from 250,000 to 300,000 square miles, performs various duties for other departments of the Provincial government—police, highways, health, liquor control—and sometimes for the federal government, as in the payment of treaty money.

In addition to these official tasks, the department gives its services to residents of remote settlements in time of illness or accident when transportation to the nearest hospital hundreds of miles away may mean the saving of a life. The pilot frequently risks his own life.

The only mercy flight in which the service lost a plane was undertaken in June, 1940, when a pilot consented to fly through a storm in an attempt to get a two-year-old girl with a fractured skull to a hospital in Sault Ste. Marie, from Hawk Junction.

The plane, carrying pilot, injured child, doctor and another man, got away just after dark on a Saturday evening. Battered by the storm over thick forest along the eastern shore of Lake Superior, the plane ran out of gasoline and came down on an inland lake. The pilot was thrown through the windshield into the water but was able to swim around and open the door and get the other occupants out before the plane sank. The child was found to be dead; a post-mortem examination, however, indicated that she had died before the plane had crashed. The three men managed to exist without food and with little sleep for four days and nights until they were rescued.

A woman who was seriously ill was flown from Cockburn island to Sault Ste. Marie in the winter of 1939-1940, when there was no other way of getting her out except over the ice. A number of Indians have been flown out from Port Hope, 100 miles north of Lake Nipigon,

and it is not uncommon in autumn for forestry airmen to be called upon to locate lost hunters.

One of the most unusual accidents of any air service took the lives of a pilot and a deputy in 1936, between Port Arthur and Fort William. The pilot, who seldom wore a belt while flying, accidentally threw himself out of his own plane. The two men had taken off from Port Arthur to do a patrol over an area in which fires had been burning. The pilot, seeing a "cold front" coming in off Lake Superior, knew he couldn't reach his destination. He therefore scribbled a note on a pad: "Do you want to go back or is there any other work we can do?" and attempted to hand it to his companion. As he leaned over his foot must have slipped and struck the control stick. The note was still in his hand when his body was found.

Four members of the service were killed in one accident in 1931, and one man was killed in another crash the same year, officials report.

One pilot punctured a float in a forced landing on an isolated lake, and, although injured, he succeeded in pulling his plane in close to shore where it couldn't sink. He cut timber and used it to jack up the leaking float, next moulded a patch of birch bark, then one of aluminum. Using a screwdriver as a drill, one-half turn at a time, he put on and sealed the patch. It tore off on the first take-off but the resourceful flyer was able to reach his base safely.

The operating session for the air service is from May to October (shorter at northern bases). During the off-season all planes requiring major work are brought to Sault Ste. Marie, where every engine is overhauled at 300 or 350 hours.

In the list of 50 or more pilots who have flown with the Provincial Air Service and later "gone commercial" appear the names of distinguished Canadian aviators. According to officials of the service, these include: George A. Thompson, Ted Stull, F. J. Stevenson, T. B. Tully, J. Metcalf, H. A. Oakes, J. O. Leach, P. M. Reid, Romeo Vachon, Duke Schiller, Al Cheesman, A. C. Heaven, Eddie Waller and Leigh Brintnell.

END

## Australia Builds an Air Force

(*Continued from page* 24)

production men who see it.

By March, 1938, licenses had been negotiated, most of the jigging and tooling finished, and drop-hammers began to bash out the first sheet-metal parts of the Australian version of the NA-33 while in the engine department, forgings were bored and turned and drilled for the cylinder-barrels of the first Australian-made 600 h.p. engines.

Australian light industry generally was not then accustomed to working to aircraft precision so it was necessary to make in the CAC plant a bigger proportion of the airplane than any other manufacturer in the world — fuselages and engines down to screws and studs, nuts and bolts.

A year after the first part was stamped out, the first airplane was ready. In outline, it was an NA-33; but there were differences. The wing of the Australian-built airplane that flew on March 27, 1938, was an NA-33 wing only in aerodynamic outline. Extra rows of rivets told of stiffening; main bomb-load was carried outside the airscrew circle. Because it had to be a general purpose machine, there had been changes inside. The observer could kick a catch, swing his seat round and slide into the new prone bomb-aiming position for level bombing.

Two guns pointed forward, one aft. Not much by today's standards, but the *Stuka* still has no more, nor have some other dive bombers. Test flights showed the airplane did all it was supposed to do: 225 m.p.h. top, 600 mile range, handle like a pursuit ship—better than a fast one. It was given a new colorful name—*Wirraway*, the Australian aborigine word for Challenge.

The story since then has been that of any successful airplane plant: expansion, expansion, expansion. Now 5,000 employees work three shifts at the factory. From the test field runway RAAF pilots take off, every so often, ferrying *Wirraways* to service stations or advanced training schools.

The war revolutionized production schedules. By 1940 it was impossible to buy even the smallest part of an airplane from Britain or America. Technicians had to revise their plans and make everything in Australia. So instead of gradual establishment of local airplane manufacturing, the whole job had to be done almost overnight.

Besides the *Wirraway* and *Wackett* trainer, the Bristol *Beaufort* torpedo bomber is being mass-produced, and De Havilland Aircraft Proprietary Limited are turning out *Tiger Moth* elementary trainers at the rate of two a day. Engines for all these types are made in Australia. A $1,200,000 forge plant is making forgings for engines and propellers. De Havillands are operating a $1,000,000 plant for production of controllable pitch metal propellers of several types. The second largest type of drop hammer in the world, a monster 35,000 pounds air hammer capable of turning out the largest aluminum drop forgings, works in conjunction with this plant.

Two factories are supplying aluminum alloy sheets for airplane making. One of them, a $2,800,000 outfit operated by Australian Aluminum Company, fabricates aluminum alloy plates and extrudes all the aluminum bars, rods, tubes and structural shapes needed in aircraft construction.

Landing gear is made in a $600,000 plant elsewhere and in factories and machine shops scattered far and wide through the commonwealth, a full range of aircraft instruments, engine generators, magnetos and starters, fireproof gas tanks, spark plugs, low tension electric cable, electron castings, aircraft fabrics, high pressure hose, bomb racks and bomb sights are being turned out. In the production of aircraft steels, Australia is self-sufficient.

It is estimated the Australian production of aircraft and aircraft parts this year will exceed the value of $80,000,000 being aimed at by the close of 1941. Large proportion of this output will belong to the Commonwealth Aircraft Production Commission, the Government-owned concern formed in 1939 to make *Beaufort* aircraft in Australia.

An Australian-made Bristol *Beaufort* bomber was at Khota Baruh in northeast Malaya when a handful of RAAF planes beat off the first Japanese attempt to effect a landing there. When the Japs came again in strength, with a fighter cover, it was a case of too few against too many—and the yellow men won a footing for facing south.

But Australian flyers, proud of the performance of their American Lockheed *Hudsons*, still had a good word for the sturdy *Beaufort*.

The work of making the *Beauforts* is spread over three Australian states, the division being decided by the location of suitable equipment and sub-contractors with private engineering workshops. Minor parts pour into assembly plants from all directions, and all manner of workshops. Even the bush blacksmith and upstate automobile or tractor service shops are producing their quota, on time.

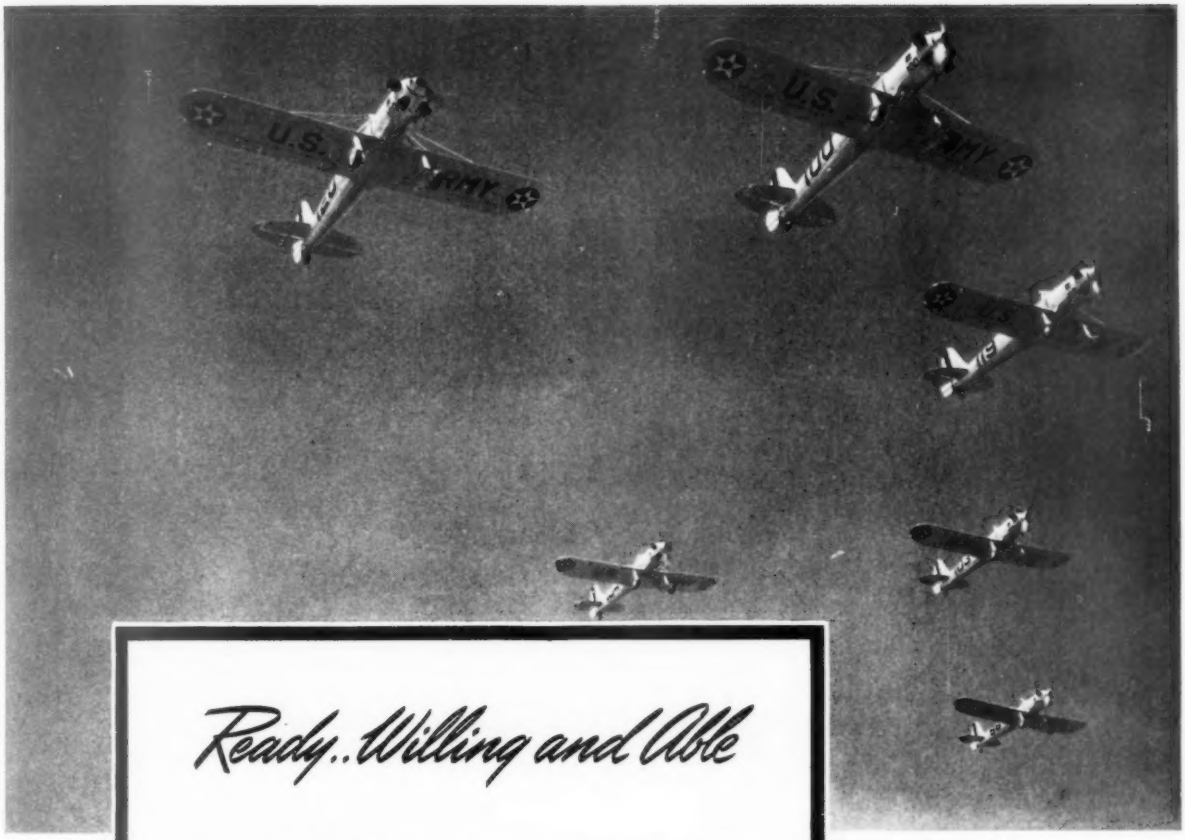
Railway workshops begin the assembling which is completed at the main factories in New South Wales and Victoria. More than 33,000 jigs, tools and fixtures are used to make a *Beaufort*, and Australia had to make 26,000 of them. More than 150 sub-contractors were on the job a few weeks ago. Of Australia's 7,000,000 men, women and children, 8,000 men and women will soon be engaged solely on making the airplane types in the Aircraft Production Commission's manufacturing schedule.

To oversee such a production mosaic as the Australian manufacture of aircraft, the Commonwealth Government in January appointed Essington Lewis, successful, hard-driving head of B.H.P.—the huge Broken Hill Proprietary Company—as Director of Aircraft Production. To obviate delays, and as a clear indication of the importance with which aircraft manufacture is regarded, the government handed Lewis almost unlimited regulatory powers.

He has sole control of the management and operation of factories and workshops doing the job. He may acquire new factories or premises for the construction and maintenance of aircraft or parts, control the output of any person or organization making aircraft, or capable of making it. He can take steps to secure material, tools and equipment; he can employ or train personnel, vary or set aside existing contracts or agreements, decide priorities. He can take over property rights, licenses or privileges, and use any inventions he may need.

Amazing as development has been, Australia knows it is still not enough. Fighters and long-range bombers must reach Australia from the United States if Australia is to be the base from which United Nations airmen will smash at Ja-

(*Continued on page* 110)





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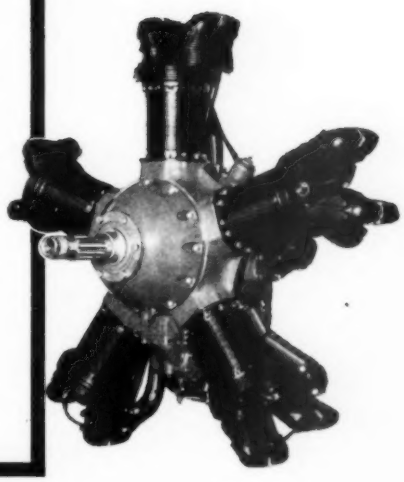

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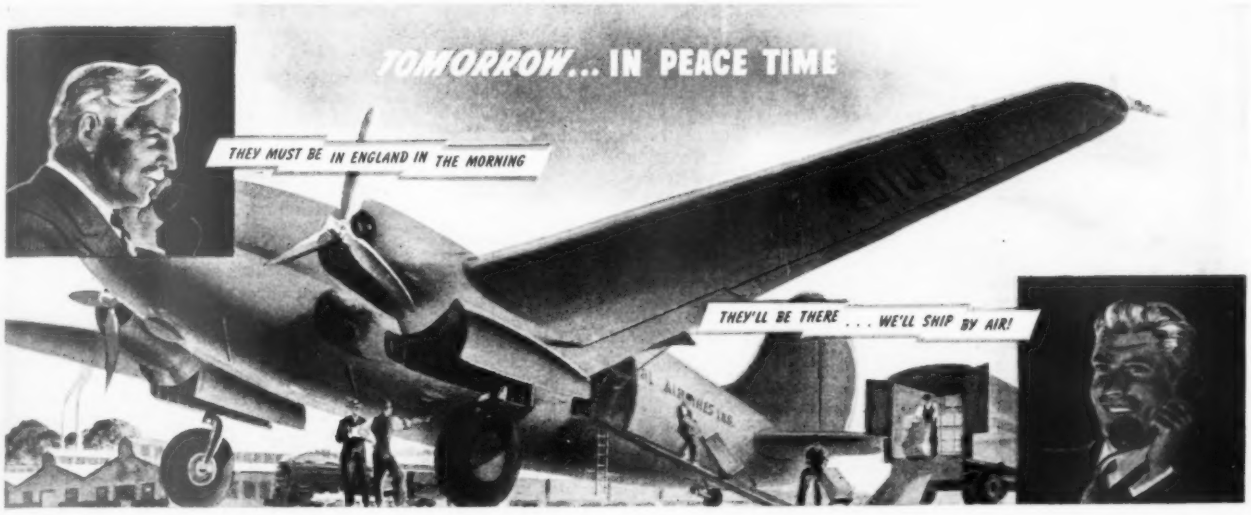


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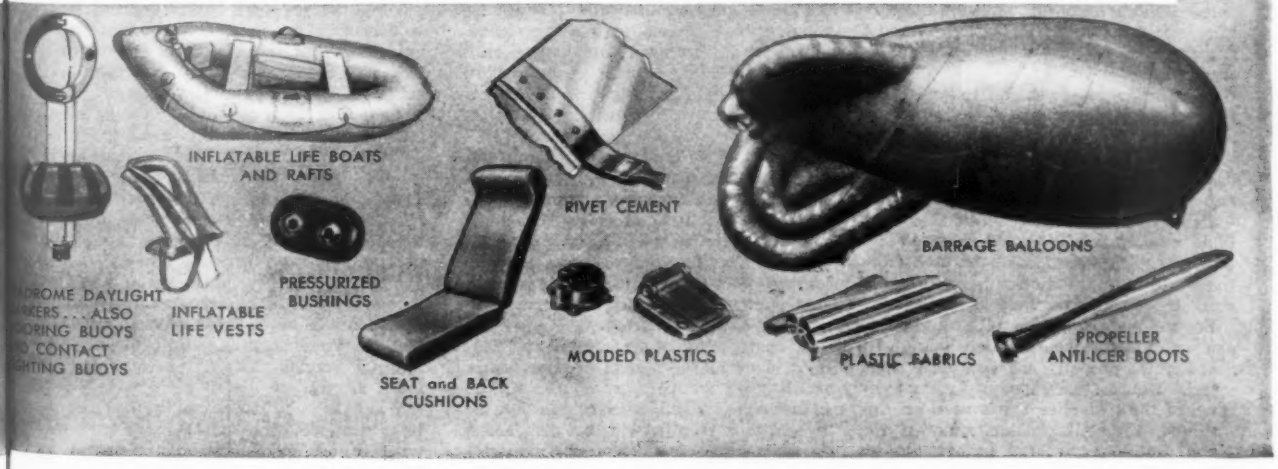
## MATERIALS FOR THE AIRCRAFT INDUSTRY



(*Continued from page* 104)

pan and Japanese bases in the south Pacific.

Australian Minister of Aircraft Production Cameron announced on April 22 that Australian-built fighter airplanes "soon will be undergoing initial tests"—but Australia cannot hope to produce them speedily enough to stem any large-scale Japanese attack, or even to replace adequately the wastage of fighter aircraft providing umbrella-cover for our bombers.

According to Cameron the fighters have "all the marks of speed and efficiency" and it is a fact Australia is not standing still when tackling aircraft manufacture, or blindly following the designs of America and Britain.

Australia is capable of improving airplane design and there need be no worries about the aptitude of her workmen or the ingenuity of her engineers. By substituting American engines for British *Taurus* engines, miles per hour were added to the speed of the Bristol *Beaufort* in Australia. This in spite of all the adaptations necessitated by the changeover. Component parts of the airframe, and many of the systems working in relation to the engines—electrical, fuel, oil and ignition, for instance—had to be re-designed.

But nothing can be done except by her allies to alter immediately Australia's major war disability — that of population. She is a small country doing a big job industrially as well as in the front lines of land, sea and air warfare. Australia is proud of the progress she is making in the specialized and highly technical field of airplane manufacture, but she is well aware of her dependence upon America for so many of the frontline aircraft that are needed to beat down the Japanese.

Australia is looking after herself with regard to training aircraft. Service flying schools all over the country are getting hundreds of reliable hours from locally-made *Tiger Moths*, Wackett trainers and *Wirraways*. Australia is determined to better her output aim of 20,000 pilots, observers and air gunners a year. Of these, only two-ninths do any flying training at all anywhere other than in Australia and on Australian-made airplanes.

That's the aircraft picture down under. Good, but not good enough for Australia —yet.

END

## Ground vs. Flight Engine Tests

(*Continued from page* 53)

dence, since neither flight airspeeds nor power conditions were simulated on the test stand. Continuous runs were made at 60 per cent rated r.p.m. and approximately 20 per cent rated power for determining stabilized engine temperatures as an indication of ground cooling characteristics for extended taxiing conditions. Frequent short runs up to rated and take-off powers were made to determine the functioning of equipment under these conditions, but stabilized temperatures could not be obtained under such conditions on the ground tests.

Carburetion tests in flight agreed closely with test stand results for low altitude operations. Difficulty was experienced, however, with carburetors enrichening at high altitudes due to improper compensation, a characteristic not tested in preliminary work but which has since been studied thoroughly by the carburetor manufacturer in both ground and flight tests, and a solution for which is now known.

Carburetor pre-heat, as indicated by test stand results, was slightly optimistic although subsequent flight tests showed that the heat rise was increased considerably by closing the cowl flaps, which had not been done in the original tests.

Exhaust back pressures, obtained with high power conditions, agreed closely with values obtained in flight both from the standpoint of maximum back pressure and distribution.

Engine and propeller vibration characteristics have been previously investigated on the propeller manufacturer's test stand. Due to the unusually wide platform of the propeller blade used on this airplane, rather high excitation of the blade frequency (27/16 order) due to propeller-fuselage interference was to be expected and actually found in flight tests. Since no means had been provided to excite the propeller blade frequency on the test stand, little response was recorded in these vibration tests. Another order of vibration, the $3\frac{1}{2}$ order, was fairly high on the airplane and somewhat lower but of the same characteristics on the stand. The reason for this difference in amplitude may be that the test engine was rigidly mounted on the propeller manufacturer's stand, whereas flexible pedestal mounts were used on the airplane, thus accounting for a change in amplitude without affecting the frequencies at which resonance peaks occurred. The results of these test stand vibration runs would have been improved by more careful regard to reproduction of test conditions.

Fuel flow tests were run as a bench test separate from the engine to determine the effects of altitude and fuel temperature conditions on fuel pressures and flow. The results obtained were somewhat conservative compared with flight test results.

Numerous arrangements for flame suppression were tested on the stand resulting in a simple means to eliminate torching of the exhaust collector. This device has since been tested in flight and proven to be an excellent flame suppressor. The ability to try a multitude of ideas on the test stand undoubtedly accelerated the solution of this program.

A comparison of test stand and flight data leads to the logical conclusion that in all cases where reasonable similitude conditions prevail, the correlation between test results will be satisfactory. *However, since one of the most important functions of pre-flight testing is to determine engine cooling characteristics and as these conditions cannot be accurately simulated on the simple test stand, it was concluded that this method of testing is not sufficiently reliable to warrant proceeding with fabrication on the basis of such tests alone.*

For cooling tests it is essential to simulate flight airspeeds, power conditions, and fuel consumption to obtain accurate data. For vibration testing, air-speeds, aerodynamic interference effects and power conditions should be simulated. For accelerated service runs, to determine the serviceability of an installation, cooling conditions, vibration characteristics and fuel consumption need to be simulated. These requirements suggest either flight tests on the installation or full size wind tunnel tests.

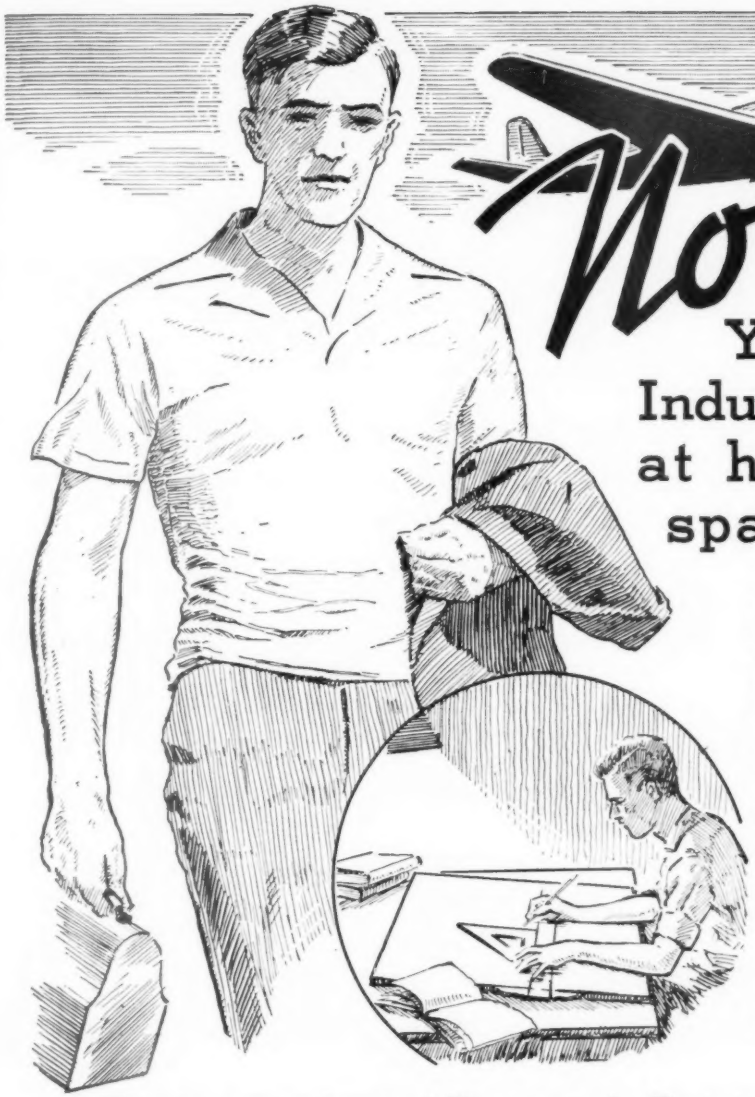
Several means of obtaining satisfactory airspeed conditions, the most important factor to be considered in preflight testing, may be mentioned. An airplane flying test stand may be used with the engine installation under investigation, serving as motive power. However, the time and expense involved in making thorough, carefully controlled flight tests of this type should be compared with ground testing methods.

Still another means for creating flight velocities over the test installation is to provide an auxiliary propeller or fan some distance ahead of the test propeller which creates a blast of air of a diameter slightly greater than the nacelle. Although this method provides a means to cool the engine, permitting operations at full power to be conducted, it is not satisfactory for determining critical cooling conditions because of the difficulty of accurately measuring the effective velocity acting on the nacelle.

Another method for creating higher celocities on a ground test stand, are used by a number of manufacturers with some success, is to place the engine and propeller installation at the throat of an open return type wind tunnel. Model tests conducted at Vega Aircraft Corporation indicate that by proper design of the wind tunnel, throat velocities of approximately 150 m.p.h. may be obtained with a 2,000 h.p. engine and 15-foot diameter propeller.

The final proposal for increasing test velocities is to provide an adequately powered wind tunnel, preferably of the closed return type with the test installation at the throat, supplying its share of the total power. The most efficient arrangement of this kind in current use is the single return type with guide vanes at the corner and long gentle expansion between the test section and first corner. One disadvantage of this type of tunnel is its tremendous size to accommodate a throat diameter large enough for engine and propeller testing. A means for reducing the size of the wind tunnel might be accomplished where the walls of the building form an expanding annular return passage for the flow of air.

When high altitude conditions are to be simulated, the closed return type wind tunnel, evacuated and refrigerated



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to altitude conditions, becomes necessary. For such tests the compactness of the wind tunnel arrangement is important from the standpoint of construction, evacuating equipment and temperature control equipment costs.

From the methods mentioned and others which may be devised, a wide selection of possibilities is available to satisfy economic and time considerations as well as test conditions, by which the following characteristics may be proven on the test stand before flight testing begins: shakedown tests, engine cooling, oil cooling, fuel flow and vapor lock, carburetor icing, exhaust back pressures, turbo-supercharger functioning, exhaust jets thrust and flame suppression, engine detonation under service conditions, measurement of drag of engine installation, propeller and engine vibration and serviceability of installation. This work done effectively will reduce the amount of flight testing with its resultant cost, required to approve a new model.

Equipment recommended after consideration of the numerous tests to be conducted, convenience of testing and general economy for a five or 10 year program, consists of a closed return tunnel with throat approximately 25 feet in diameter and power adequate to simulate cruising speed.

An analysis of the normal operating costs, including depreciation and interest on investment, shows that such tests may be conducted more economically than even the direct costs of flight testing, the advantage increasing with the size of the airplane involved. It also avoids the cost of tying-up a prototype whose value may be extremely high.

It is safe to say that, on the average, thorough development and service tests may be accomplished in the wind tunnel in a shorter elapsed time and at a fraction of the total cost than development tests conducted only on the airplane. The logical conclusion is that every airplane manufacturer should own or have access to an adequate engine test wind tunnel.

END

## "I Flew with the RAF"

(*Continued from page* 46)

But if you can't, circle with him and keep circling. Moving in at you at high speed, the centrifugal force will keep him on the outside of the circle, and you could get your share of shots back at him. It isn't any fun at all when only one flyer is doing the shooting—and that flyer is the other fellow!

Fighters in this modern war must constantly keep on their toes. The enemy always is attempting some new trick, sending out new types of planes, mounting the guns differently.

In the early days of the war the first models of the *Hurricane*, so veteran fighters told me, were greatly excelled by the Germans in the matter of altitude.

British pilots would fly to their ceiling, shake their fists at the Germans, scream curses at them. They would fire futilely at the Hun planes. The Germans would grin mockingly and stay out of reach or, if an attack was ordered, would enter the fight at an advantage, swooping down from the superior height.

Everyone has heard of the miracle of Dunkirk. But few people really know how this miracle came about; why many more thousands of British troops did not die under the machine gun fire and bombs of German planes. The miracle, so I am told, was the Boulton-Paul *Defiant*, a two-seated fighter which had just been issued to the RAF. The *Defiant* was equipped with four machine guns at the rear. These guns, handled by a rear gunner, swung as a unit, in a 360° arc. Despite the extra man, the *Defiants* resembled the early *Hurricanes*.

The RAF gave the retreating, swimming British a fairly heavy covering of *Defiants*. The Germans came down on these planes from above, expecting an easy prey, to be met squarely in the face by four machine guns. The *Defiants* exacted a heavy toll of German Messerschmitts in the air over Dunkirk and many thousands of British lives were saved by them.

Incidentally, it was a high-flying *Spitfire* photographic plane which, I am told, directly prevented Hitler from following up Dunkirk with a full scale invasion of the British Isles.

Within a few weeks after the collapse of France, photographs of a coastal region showed many hundreds of barges assembled. The British studied the photographs, decided that it was the real thing, and sent over hundreds of planes, bombing the barges night after night until Hitler thought better of his plan.

This photographic plane, incidentally is a regulation *Spitfire*, with all excess weight stripped from it. It carries no armament, no defensive weapons. But it does carry a tremendous amount of gasoline. About three times that of the regulation *Spitfire* capacity. The plane can exceed 40,000 feet altitude. From this great height excellent photographs are taken with wide lens cameras.

The plane can't be touched either by antiaircraft fire or by Germany's best Messerschmitts. The atmospheric haze is completely missing from such a stratospheric height, so that the pictures of the terrain almost always come out remarkably clear.

These high flying photographic planes bring the negatives back to home station. They are developed quickly, enlarged slightly and placed together until a complete map of the terrain is revealed. Then the whole may be re-photographed for extra copies. The work is done at high speed.

If the pictures have been made in preparation for a bombing attack, all the pilots and the bomber station officers go over the photographs with the photographer. The targets are pointed out. That night (or sometimes in daylight) the bombers roar off, to blast the targets which the high flying photographic plane has "spotted" with its lenses.

When I left England the *Hurricanes* were armed with 12 guns altogether, either all machine guns or machine guns and cannons. The Germans always are experimenting with varying numbers of guns for their planes—and so are the British.

So far I have mentioned mainly German and British planes. The American *Airacobra*, in my opinion, is one of the sweetest fighting planes yet developed. It has several advantages over the *Hurricane*, *Spitfire* and Messerschmitt, such as the absence of motor in front and its pointed nose permitting the flyer to see the ground as he is landing; and the tricycle landing gear—which enables a good pilot to land the ship at high speed without tipping over. The perfect balance of the ship and the fact that the engine is directly back of the pilot also are great helps. The engine, in this position, protects the lower part of the flyer's body from attacks from the rear—while the armor plate on the back of his seat protects the upper part of the body.

In regard to the British secret night fighter equipment, I can say only, of course, that it tremendously increases the effectiveness of the fighter at night. One of the favorite tricks, incidentally—which both sides employ—is to follow an enemy plane home at night and, after the homecoming plane is given a flarepath, cut loose on the field with bombs and guns.

The bomber in a daylight raid receives the hottest kind of a reception. In sending over a squadron of bombers, Jerry will protect it with three to five squadrons of fighters.

The bombers come over at about 25,000 feet. There will be a squadron of fighters on each side of the bombers and the remaining fighters up 3,000 to 5,000 feet higher, probably at different levels.

When a British squadron leader sees bombers, he sees red. Instantly, the RAF planes strike for the bomber. The Messerschmitts attack the British fighters, but the British don't give the fighters a second look. There is no sense, the British figure, in their fighter planes doing battle with German fighters—no matter how many there may be—when there are bombers in the air striking at their cities and citizens. So, although they may leave themselves wide open, the fighters sweep in at the bombers. I have known of a single British pilot attacking a German flight of 50 planes. He was an Australian sergeant pilot and later he lectured to us on the way he made the attack. Coming up from below, he got the rear plane on the left side of one of their "V" formations. Sweeping on above the squadron, he came down from above and got the squadron leader. Turning again, he came up and got another and knocked down a fourth as he swept down from the top of his curving attack. Then he got away and headed for home.

Immediately (and note this) this pilot was put to work diagramming his at-

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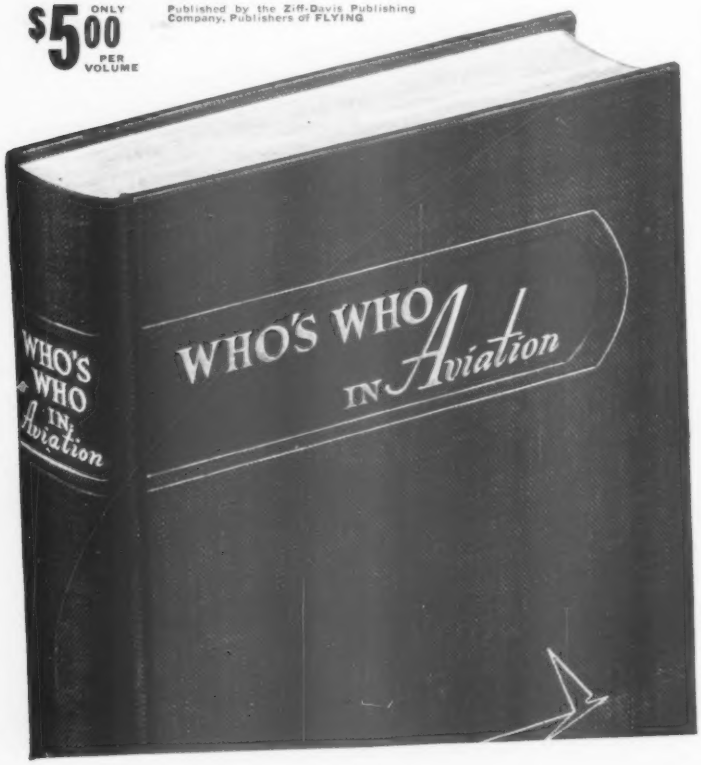


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tack and teaching other pilots how it was done.

I know of another pilot, just as daring and just as good a flyer, who brought down two Germans in one air battle—all the Jerrys that were involved—and promptly was court-martialed and discharged from the air force.

This officer, a flight lieutenant, was up on a "sector-recco" flight with a couple of "green" flyers who were just learning how to handle their planes.

By accident, they ran into two German planes and a snappy scramble ensued. The British officer went to work on those Germans and finally shot them both down—and returned to his station alone.

"That was good work," he was told at home station, "but where are the two men who went with you?"

"I don't know what became of them," he said, "I concentrated on the Germans."

But while he was concentrating on these Germans, the Germans were concentrating on his two rookies. Before the lieutenant got the Germans *they* had shot down the green British pilots.

The officer had sacrificed team-work, lost the lives of two men and forfeited his commission.

Both sides are flying terrific machines of death in this air war today and, because they are flying such machines, the utmost in teamwork is demanded all around and under every circumstance. An erratic human temperament seeking individual glory, at the controls of such a plane and with death at his fingertips, might be the cause of the loss of many lives. So, modern air warfare is a combination of human reflexes, high-powered machines and teamwork.

The greatest of these is teamwork!

END

## Favors "Aircraftsman"

ADOPTION of the term "aircraftsman" to replace the commonly used designation "mechanic" is suggested by Jerome Lederer, director of the Safety Bureau, Civil Aeronautics Board. He points out that the advantage is that it would set the aircraft mechanic apart from other mechanics; it would show that he deals with the air, and that he has a definite craft, thus adding to the prestige and dignity of the vocation. The British long have termed their aviation mechanics as aircraftsmen.

## Licenses

PREPARED as a special bulletin for FLYING, the following monthly statistics were released by the Civil Aeronautics Administration:

| | September 1 | |
|---|---|---|
| | 1942 | 1941 |
| Pilot certificates of competency | 105,569 | 86,919 |
| Student pilot certificates | 112,340 | 92,691 |
| Glider pilot certificates of competency | 210 | 154 |
| Student glider pilot certificates | 454 | 528 |
| Mechanic certificates of competency | 16,317 | 13,083 |
| Parachute rigger certificates of competency | 755 | 479 |
| Certificated aircraft | 22,871 | 22,829 |
| Certificated gliders | 91 | 56 |
| Ground instructors' certificates of competency | 6,803 | 3,943 |
| Air-traffic control-tower operators' certificates of competency | 1,054 | 390 |
| Air carrier dispatchers' certificates of competency | 495 | 428 |

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## Speed-Up Specialists

(Continued from page 21)

have banded together because of their geographical proximity, but their help is available to any factory in the country which may need it. To them the slogan "Keep 'Em Flying" means exactly what it says, no matter what it may entail.

The Council functions as a co-ordinating group and formulates policies, but the plan works on a purely informal basis. Committees of specialists handle such subjects as production, materiel, engineering and standards, transportation and housing, plant defense, accounting, industrial and public relations and industrial training. These committees fortunately have power to act—and they do.

If Lockheed is having trouble with a new turret, research data from any Council company may help solve the problem. A staff of engineers may be borrowed. The solution usually comes quickly, and no bills for services rendered are passed around. America simply has a new turret in a great big hurry, and we're that much nearer victory.

If the problem is simpler, the solution is simpler. If a Douglas metallurgist wants to do some heat treating on a Sunday, and hasn't a furnace handy, he can call a pal of his at Northrop, ship his parts over there to an empty furnace and have them back in time for the Monday day shift to slap them into airplanes. One harried crew chief actually called the Council on the Fourth of July and borrowed a roll of scotch tape from another plant, so that America could celebrate its Independence Day by building warplanes without a halt.

A typical monthly report of material exchanges mentions such items as 15,390 rivets—vital to the steady flow of assembly lines, 2,800 cotter pins, 9,889 bolts, 42,605 nuts, 26,459 screws, 3,400 feet of conduit wire, six engines, 24 blue fluorescent lamps, 5,000 curtain fasteners, 25,000 feet of electric cable and thousands of other important items. A curtain fastener may not be a glamorous part of aviation, but when a troop transport is held up for the lack of one fastener it becomes mighty important. The War Priorities Board is doing a big job in allocating material to the various plants months ahead of schedule, but when a four-engined bomber is sitting at the end of the assembly line waiting for a cotter pin in a landing gear wheel, it's no time to holler to Washington for help. The boys in Southern California have figured out how to take care of such troubles themselves.

Sometimes the whole industry is short of certain items (no doubt you've heard of the rubber situation). The AWPC again steps into the picture when such shortages occur. In the case of rubber the various committees have found substitutes or discovered ways of doing without rubber. The engineering group stripped several hundred pounds of rubber out of the Lockheed P-38 by shrewd use of synthetics and substitutes. Douglas has pioneered in the use of plywood and plastics for such parts as troop benches, window frames, cabin floors, wing flaps, control surface tabs, nose wheel doors, antenna masts and other airplane components formerly made of metal. This information has been passed along to the other plants and a "no-sale" rung up on the cash register. Low grade steel is a substitute for aluminum in some cases. North American is making trainers out of the same kind of steel formerly used in "tin" bathtubs, and North American says "help yourself" to other trainer builders. Northrop has developed heliarc welding [FLYING, October, 1942] to make possible the use of magnesium, stainless steel and other metals in place of aluminum and has not only donated the process (which is the result of two years of research) but is busily engaged in making the special torches needed for distribution to other manufacturers. The members of the Council have only one complaint to make in regard to their splendid work in finding substitutes. When they find a substitute for a critical material, all war industries pounce on the new discovery and before long the substitute is a critical material itself. Then the aircraft plants go back to work to find a substitute for the substitute.

"Two more trips and I get my transport license."

The engineering reports shared between the companies have done aviation a great service. Problems which many experimenters had been working on separately have, through the Council, received the collective attention of many experts. Warplanes of today, and peaceplanes of the future will incorporate advances in windshield de-icing, radio interference suppression, moulded plastic cockpit and gunner's enclosures, weight elimination and many other contributions to better aircraft construction. While most effort is devoted to solving of production problems at present, it is entirely possible that the many fine engineers working together and pooling their ideas may come up with an entirely new and radical type of airplane or find the key to some undreamed of theory of flight which will move aviation years ahead.

For the present it is enough that the manufacturers are whipping day-to-day problems right and left. Their idea pool even extends to office procedure, salvage of waste materials and plant police problems. The committee on transportation has done a tremendous job in getting rides for aircraft workers who have no cars. Group riding plans have been worked out and publicized in the plants and the average number of riders per car has been raised to a point where the rubber saving is an important item.

A great deal of work is being done in standardization of parts and machines so that interchange of facilities can be made even easier. Machine capacities have been surveyed so that the eight plants know exactly what they have available in the way of machinery between them. Inventories information is exchanged so that stock control men can call the most likely plant in case of a shortage in their home factory. In other words, these separate business entities are practically operating as one efficient corporation, with the members of the Council as a board of directors.

The members of the Aircraft War Production Council are just about the world's greatest collection of airplane builders. The presidency is a rotating assignment, held at present by Donald Douglas, president of Douglas Aircraft Company. Harry Woodhead, president of Consolidated Aircraft Corporation has just been elected vice-president; he also represents Vultee on the Council. Other members are Lockheed, headed by Robert Gross, president; Northrop, LaMotte T. Cohu, chairman of the board; North American, J. H. ("Dutch") Kindelberger, president; Ryan, T. Claude Ryan, president; Vega, headed by Courtlandt Gross, brother of Bob. When these men agreed to share all they know and all they control, America's airpower stock went way up.

The Council has but one standing rule, "Get the planes out." Committees have been told to make their own decisions and see them through, and key men in all plants have been informed that red tape is to be cut wherever possible. When parts, machines, men or services are needed the rule is to hand them over and worry about order numbers, bills of lading and accounting, later. Profit is forgotten immediately.

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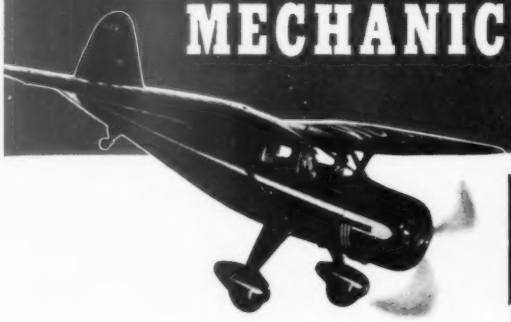

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Keep an eye on Fleetwings, brother bird-man!

A new attack bomber . . . high-speed sister ship to a famous night-fighter that's helping the RAF thoroughly trim the Nazis . . . is equipped with elevators, fins, stabilizers and rudders built by Fleetwings on new, fast, rolling production lines that have tripled output *and* improved quality.

Fleetwings realizes that lives will depend on the successful operation of aircraft hydraulic equipment at widely varying conditions of temperature, pressure, and relative humidity. Therefore, Fleetwings Hydraulic Valves, for instance, must pass rigid proof tests, body pressure tests, cold tests and torque tests. Dimensions are checked to within two one-hundred-thousandths of an inch. These valves can operate all sorts of aircraft equipment . . . from machine gun banks and bomb doors to "Iron Mike," the automatic pilot.

BUY WAR SAVINGS BONDS! That's what Fleetwings employees are doing by means of a voluntary payroll allotment plan. Almost 100% of Fleetwings entire corps of employees are participating. We're helping to build 'em—and to buy 'em! Are you with us?

"KEEP 'EM FLYING"

FLEETWINGS
Incorporated

BRISTOL • PENNSYLVANIA


America will have its 60,000 planes this year and more. Next year the figures can be raised again when new plants go into operation, but a lot of the credit for getting us over the first big hump, and keeping the planes rolling off the assembly line, must go to the practical men who had the vision to forget their own affairs in the face of their country's need. These men formed the Aircraft War Production Council as a mighty tool to aid our production effort. After the fuss is over they may go their separate ways in a terrific scramble for the top share of the world's peacetime airplane market, but right now they're giving us all a wonderful lesson in unity.

END

## AOPA News

(*Continued from page* 50)

The light-gun procedure is far from standardized throughout the country, and we are inviting the opinion of AOPA members as to the simplest and most positive manner of projecting light signals to control taxiing, take-off and landing operations. Most of the confusion seems to revolve around the use of the green light as a go-ahead signal for both taxiing and take-off, creating a situation where pilots frequently mistake a taxi signal for a take-off signal.

### Lawrence S. Lawver

Lieut. Lawrence S. Lawver, of Freeport, Ill., was fatally injured September 8, 1942, while flying as co-pilot in an Army bomber which crashed in Ohio shortly after taking off from Wright Field, Dayton. Lieutenant Lawver was for several years an executive assistant at AOPA headquarters and was most active in the organization and operation of AOPA. Larry's death was a shock to his numerous friends in private flying circles, and deepest sympathy is extended to his parents, Mr. and Mrs. S. H. Lawver, of Freeport, Ill., a brother, also in the Air Forces, and his wife, Mrs. Elsie Lawver.

END

## Pilots' Eyes

(*Continued from page* 31)

tive experimental work. In 1924, after years of investigation and research, it was discovered that, by a careful balancing of ferrous and ferric iron ingredients and the addition of other oxides, an olive green glass could be made which gave a peak of maximum transmission of useful light closely coinciding with the peak of the curve of eye sensitivity, and at the same time gave excellent ultra-violet and infra-red absorption.

The first use of the new glass was in the industrial field where those exposed to glare found the glass gave definite protection against radiation which tired and irritated eyes.

Later, in an attempt to solve the cause of flyers' headaches and eye strain, the U. S. Army Air Corps investigated the possibility of using the glass in flying. Tests under actual flight conditions proved that, for high, continuous flying, the glass gave eye relief never before experienced, a cooling effect being particularly noticeable. It was also found that in Air Corps field reconnaissance, observation and piloting the glass did not distort color values—an important point, since the detection of false color and untrue foliage is essential to successful flying operations.

Another factor had to be considered. The lenses of earlier goggles were mechanically designed without regard for optics. No attention had been paid to the fact that a deeply curved lens of zero focal power, such as used in aviation goggles, actually had an optical center which must be properly placed in exactly the same way as if the lens had power like an ordinary prescription lens.

After wearing such defective lenses for short periods of time, they caused severe headaches which decreased the pilot's efficiency. It was therefore necessary to create a new optically designed lens out of the new glass. This lens permitted true eye-co-ordination and therefore accurate, comfortable seeing. On wearing the new lenses, the flyers were delighted to discover that their headaches had vanished.

On the basis of this relief from eye-strain and glare, the new type absorptive lenses were adopted as standard by the U. S. Army Air Corps and specifications were set up as follows: "The anti-glare glass shall be known as Calobar, or its equivalent . . . the glass shall have high absorption throughout the ultra-violet and near infra-red regions of the spectrum, in order to protect the eye from the harmful effects of intense sunlight."

Wearing comfort of aviation goggles has also been the subject of intense research. Soft sponge-rubber cushions now conform exactly to the face. Also available is a one-piece sponge-rubber face mask; smaller, cooler and more comfortable than the usual mask. It fits the face snugly, without noticeable pressure, and consequently is exceptionally comfortable.

Another innovation is an ingenious ventilation system to keep the lenses clear. Indirect air currents behind the lenses discourage fogging. Actual flying tests have proved the efficiency of this simplified ventilation system to the entire satisfaction of the U. S. Army Air Corps.

For flyers who wear glasses, aviation goggles can be obtained behind whose corrective lens assemblies may be worn. And for cabin planes, glare-protection goggles of the spectacle type are available. Lenses of these goggles can be ground to prescription for defective eyes. Both aviation and cabin-type goggles can, of course, be had in clear white glass if desired.

In short, thanks to optical science, the utmost in comfort and efficiency has been engineered into present-day aviation goggles. Steps in their manufacture are shown in the accompanying photographs.

END

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## I Learned About . . .

(*Continued from page 68*)

roar. The ship refused to move. I performed the same snowplow operation in front of each wheel, under the fuselage, ahead of the tail. Inch by inch, I hauled it to the tower. I tied it under the framework. I walked hopefully to the shelter house. Perhaps there was a telephone? The door was locked. I looked down the darkening mountain.

There was a trail, but no road. As usual, because it saved changing clothes at airports that had no facilities for privacy, I was flying in a dress, silk stockings, high heels. Brush ripped my stockings to shreds. My legs were bleeding. Halfway down the mountain, the heel broke off a shoe. My sleeve caught on a thorny bush and clung until I tore it loose, as I burst into tears of exhaustion.

It was pitch-dark when I reached the highway. Perhaps that is why five cars passed the hobbling bedraggled object that I had become, before one driver took a chance and picked me up. He delivered me to the hotel. I hobbled up to the desk. I reached for the register.

"What happened to you?" said the clerk.

"I landed on the mountain up there beyond the town," I said. "In an airplane." I didn't want him to think I'd been riding a broomstick.

"On the mountain?" said he, blankly. "Above *this* town? Above *Shenandoah?*" (Anywhere, I suppose, just anywhere but Shenandoah.)

"Yes," I said, shortly. "Lead me to a room. Lead me to a bed. Please."

"You're sick," he said.

"Dead," I said.

And it's funny. Beyond knowing I should have turned back sooner, I hadn't been able to figure out what had happened and why. Where HAD that extra altitude gone that the altimeter said I had left between me and the mountain?

"Golly moses!" I said. "When the barometer kept dropping, the altimeter kept reading higher! The lower the pressure, the worse the storm, the higher the altimeter. I didn't *have* any extra altitude! Gosh!"

"Oh," said she, helpfully. "I brought you a hot water bottle."

"Thanks," I said, and didn't enlarge my explanation. I had plenty of explaining to do the next day to the boss. A reporter had watched my snow-plow takeoff out of the drifts between clutching trees. He had put a story on the wires: "GIRL FLYER NARROWLY ESCAPES DEATH." A *nice* story, said the boss, pointing out that I was hired to sell the safety of flight.

But should I tell *him* that I had forgotten such simple meteorology? I flushed. "I'm sorry," I said. "It won't happen again."

And it won't. Not because I forget what happens to altimeters in storms anyhow. I learned about flying from that!

END

## Technician Trainers

(*Continued from page 44*)

mand depends on the outcome of this examination. Seventy-five per cent of all personnel of the command have made the required mark of 100 or more. Only after successfully passing the classification test does the technical training soldier go to the replacement centers. There they are given the mechanics aptitude tests that grew out of the simple "erector set" beginning.

Once a soldier has shown ability to absorb specialist training, he is sent to the technical schools for which he is best suited. The choice of course is on a democratic basis. The soldier is given a chance to make a selection and his selection is given primary consideration when practical.

The basic course of instruction given most students is of 18 weeks duration and would cost a civilian more than a thousand dollars if he attended a commercial school. For example, a civilian studying to be a weather observer and forecaster can take such a course in college only at a cost of several thousand dollars, according to the training experts, but an enlisted man of the Technical Training Command can get the same course without charge or the usually required degree. Soldiers assigned to this Command can, therefore, not only aid in their country's war effort, but can equip themselves for specialized work at the conflict's conclusion.

The largest group of specialists are those enrolled in the airplane mechanics course which is divided into various phases, each being devoted to the study of some particular branch. Included in these are basic instruction and practical exercises under close supervision, so that each student receives a thorough training in both theory and actual practice.

Once his training is over the mechanic is assigned to an Air Force operating base where he must spend several months under the watchful eyes of non-commissioned experts of years' experience and it is here he learns to function as a member of the ground crew. He checks the airplane's structure, its movable control connections and surfaces of the wings, fuselage, and other vital parts to be certain they are tightened, oiled and safe. Others check the instruments, fuel, wiring, tubing and all parts of the plane, making it ready for flight at a moment's notice.

But do not think the technically trained Air Force soldier functions only on the ground. Everywhere the big bombers fly, these men are members of the flying crews. Radio experts, aerial photographers making reconnaissance photographs, gunners, flight engineers, all are there. Their unified effort is essential for the accomplishment of any flight mission. It is certain their contributions to the victory will be magnificent.

Recently Maj. Geoffrey Bonnell of the Air Forces Ferry Command told of the

## ...IS OUR JOB

Training young men
In all phases of aviation
Has been our job
Since the establishment
Of our school in 1926.

This is still our job
But it has become
A bigger job since
The beginning of the war.

We are still operating
A commercial school to train
Pilots, mechanics, radio operators,
Aircraft instrument technicians, etc.
For jobs in war industries.

But our biggest job
Is operating auxiliary
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Army Air Corps to train
Pilots and mechanics for
Immediate war service.

We are proud of
The men we have trained
And also proud to have
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The full measure of our experience
And training facilities
To help win the war.

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importance of the crew and their skillful training in a ferry flight over Africa. "Having served with the RAF in the last war and knowing how they had built up an air force to function in all parts of the world without established bases or the proper equipment," Major Bonnell said, "I got a great kick out of our first formation of heavy bombers to come in at a British airdrome. They arrived in perfect formation and after landing, the crews carried on like veterans. Operating a ferrying service over desert and jungle has a thousand side-shows and a thousand problems. Sabotage, for instance, is always a threat. It forces you to doubly check every detail before a take-off, even though everything functioned perfectly on the last leg of the trip. No matter how strange or difficult the problem, each man pitches in to solve it."

Already the skilled technicians of the Technical Training Command are playing a vital role in the conduct of the war effort, as Major Bonnell testifies.

The conduct of Master Sgt. Louis T. Silva, of Rio Vista, Cal., under fire in the battle of the Netherlands East Indies, is another example of the courage and quality of men developed by the Technical Training Command. Sergeant Silva, line chief of a bombardment squadron, insisted, because of a lack of experienced gunners, that he be allowed to accompany the first bombing mission into the combat area. He operated a side gun during the flight. Fifteen enemy fighters attacked the American formation and made numerous assaults from all directions for a period of 40 minutes. During this prolonged fire from the enemy, Sergeant Silva distinguished himself by coolly operating his gun, reloading with several ammunition boxes and destroying three of the enemy pursuit planes. The attack was furious and many bullets passed through the ship's covering. One explosive bullet struck the tail gunner and broke his leg. Sergeant Silva had time and the courage to assist in removing his fellow soldier from his position. He has been cited for his "courage, coolness, and devotion to duty," setting an example by which younger men may be inspired.

The task of training thousands of men needed for the ever-increasing flight and maintenance crews is a stupendous one. The problem is in direct ratio to the plane production and the pilot training programs. Every available site suitable for training mechanics is being hastily coupled with the Technical Training Command's chain of schools in an effort to meet the rising demand for more and more ground and flight crews.

There is a strong relationship between the pilot training and the training of the equally heroic ground crews. The two branches are co-ordinated and integrated. There is, and must continue to be, a mutual respect between the mechanic and the pilot. It would be fatal for a pilot to have a shaken faith in the men who have charge of his ship's maintenance. When a plane takes flight it is all-important for the pilot to *know* that the men who conditioned his ship before it left the ground were skilled, thorough, and dependable and, further, that his ship will not fail because of the ground crew's inefficiency. It is the Technical Training Command's job to see that ground crews are thoroughly trained, skilled men.

It is, therefore, of primary importance that men selected for the exacting and responsible jobs I have mentioned here be superior mentally and physically. They must have a natural aptitude for this special training and it is for that reason the Classification Division test forms a sound foundation for the technical training program.

The source of manpower for these schools is the greatest reservoir of mechanically minded people in all the world. That source is the American youth. Curious American boys searching clocks for the "tick," dismantling bicycles, autos and radios, have had their quest for knowledge fostered in our schools by complete vocational training courses. This has made the American youth the most apt student of machinery in the world today. And the boys of today are the men of tomorrow who will keep America's air arm strong and effective.

This early "tinkering" with mechanical toys shows up in the selection tests and the Army Air Forces Technical Training Command is reaping the harvest from the years of childhood experiments by American boys.

The importance of the Technical Training Command's role in winning the victory is great and will be glorious. The training of the nation's men into experienced mechanics and technicians is of utmost importance for on them rests the burden of keeping the planes in flying and fighting condition for the final triumph.

END

## Air Transport Course

IOWA WESLEYAN COLLEGE, Mount Pleasant, Ia., has inaugurated an extensive course in air transportation to prepare its students for job opportunities in the post-war expansion of passenger and cargo air transport. Full scholastic credit is granted. In announcing the course, Wesleyan's president, Dr. Stanley B. Niles, stated: "Most Americans are not awake to the fact that the world has entered into an entirely new era, the air age. Miracles in transportation are not ahead of us, but here. The years ahead will be as different from the immediate past as the present is from the days of the ox cart. Iowa Wesleyan wishes to do its part in awaking America to what has come about and prepare it for what is ahead. Opportunity is written large for youth awake."

## Curtiss Co-Ed

CURTISS-WRIGHT TECHNICAL INSTITUTE, Glendale, Calif., has gone co-educational. In an announcement by Maj. C. C. Mosely, president, it is disclosed that the doors of the big technical school have been opened to girls wishing to embark on the 11 months' course of aeronautical engineering or the three months of aeronautical drafting.

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## A Unified Service

(*Continued from page* 40)

making of all the war plans and involving all of the military forces. This can be executed only if there is one supreme military commander to direct the plan once it has been worked out and adopted. This means that we must have a general military staff making the co-ordinated plans for the Army, Navy, and their air forces, and that everything else must be subordinated to that plan. It means that there must be a supreme military commander directly under the president and responsible only to him, who shall have the responsibility and the full authority to carry out the general staff's plan.

The nature of modern warfare, which is so completely amphibious, has made the present cumbersome, unwieldy organization of our Army and Navy obsolete and totally unequipped for the lightning-fast action of modern war. We should scrap our entire hodge-podge and intricate Army and Navy organizations and set up one military organization to embrace all the military services, including the Navy. There should be a chief of military forces, who should be the supreme military commander operating directly under the president and responsible only to him. The chief of military forces should have four chiefs-of-staff, one for air, one for what we now call the Navy, one for what we now call the Army, and one for supply. There should be a general staff, the members of which should be entirely divorced from participation in or responsibility for the actual military operations. This general staff should make the overall war plan. The Army, Navy and Marine Corps should all be put in the same uniform and merely wear the insignia of their specialized services, such as wings for the aviator, anchor for the Navy, and perhaps a tank for the Army.

With this type of organization, the formation of what we now call "task forces" would be immensely simplified. The question of command and succession to command would be greatly simplified. Today questions of paramount interest are involved in the question of who is to take command. Frequently an admiral will be in command of a task force with a general of the Army as his chief-of-staff. If the admiral is disabled or killed, the general steps up as chief-of-staff even though the major problems in the mission assigned are naval. No one qualified to speak on the subject can for one moment contend that there is complete unity between the Army and the Navy and their air forces, not so much because of lack of co-operation as because of lack of co-ordination or even of the machinery to provide proper co-ordination. There is no interchange of training and rarely is there a proper understanding by the officers of one service of the problems or even the nature of the operations of the other service.

It must be apparent to all that from now on the emphasis in modern warfare will more and more be transferred to the air. Future operations, and most of those right now, require that the commanders in the field be aviation-trained. If this is true in the field, of course, it must be true also at headquarters. Those who are to plan the strategy of war must be thoroughly indoctrinated in aviation and its employment. The burden of battle today has been transferred from the surface of the earth, whether on water or land, up into the air. Surface and sub-surface vessels and ground troops, including their mechanization, are today actually in support of air operations. This war has proved this time after time. The Germans and the Japs saw this before they started the war. It appears to be little understood yet by the United Nations. No, airplanes and aviators alone will not win the war; nor will they successfully conclude battles unless ground forces, both naval and land, are prepared and available to follow up air successes and consolidate on the surface the gains won in the air. But certainly Navies and armies without superiority in the air are not going to win the war, nor are they going to win battles. The history of this war from the very beginning has indicated that surface forces, regardless of how powerful, and even when numerically superior to the enemy, have lost consistently when their side did not have superiority in the air.

Transportation is more and more moving into the air. The more it moves into the air the more the emphasis in war will be on aerial warfare. Surface communications, whether by land or sea, cannot be maintained under modern conditions if the enemy is in control of the air over surface routes. This war has demonstrated that navies cannot operate within range of shore-based aircraft. The Western Hemisphere will be secure only when we have vast air superiority and complete air control over the seas surrounding it. The United Nations cannot hope to successfully carry the war to Japan and to Hitler until we have vast air superiority over both. Aviation will set the pattern of battles and will design the major strategy of war. The surface Navy and ground forces will secure, consolidate and hold the gains made by the airplane. There is every indication that the day of the battleship is over. The first line of the Navy from now on will be aircraft carriers. The rest of the Navy will largely be in support of these floating landing-fields and for their protection primarily. The carrier is a vital factor in modern war. In simple terms it is a portable landing field that may be moved about on the sea at will where it is most needed. It has as its purpose giving the fighting planes an enormous range, which they do not inherently have in their self-contained capacity. An adequate number of carriers makes it possible to so space landing fields for fighters that they can provide fighter-escort protection for the heavy bombers on long cross-water flights.

A big bomber is a powerful weapon against fixed land fortifications and naval surface vessels. It gives enormous range to one's artillery because it moves it into the air and permits, in effect, shells to be fired thousands of miles instead of thousands of yards.

The dive-bomber is a terrifying weapon and strikes like lightning. It is equally effective against surface vessels and submarines and can disperse movements of troops and break up and stop formations of tanks. It can wreak terrific damage on the enemy's supply bases and war industries behind the lines.

The airplane is not stopped by Maginot Lines nor by heretofore formidable lines of battleships. Rivers, mountains, breastworks or any other artificial barriers are perfectly meaningless to airplanes.

In view of this sudden and vast change in the methods and mechanics of modern warfare, there must be drastic readjustment in our military picture and in our military organization. The answer to our problem is not a separate air force coequal with the Army and the Navy, but rather a consolidation of all military branches into one military force so organized as to make possible the striking with a balanced force of all weapons wherever the enemy is vulnerable. Bureaucracy and the bureaucratic principle have crept into our military organizations until today they dominate them. Our very survival may depend upon a ruthless discarding of the age-old traditions of our military and Naval organizations and boldly organizing a streamlined and straightlined fighting force that will be invincible.

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*Editor's note: Congressman Maas wrote this article for* FLYING *before he went on active duty with the Marines. At his request, payment was turned over to the USO.*

END

## Air Mail Curtailment

THE following order of preference in the loading of mail on aircraft bound for restricted zones abroad have been announced by Secretary of War Stimson, Secretary of the Navy Knox and Postmaster General Walker: First, official air mail; second, V-mail; third, to the extent space is available, other letter mail weighing not in excess of two ounces per letter.

The three officials point out that the quantities of air mail coming within the third category that can be given air dispatch to restricted areas cannot be predicted accurately, and such matter may have to be transported by surface means. Military necessity may at any time require that only official air mail and V-mail be transported by air to such areas.

## Blackout in Reverse

AMONG new developments in wartime lighting is a plan to use a "glare barrage" to protect aircraft and other vital industrial plants. The horizontal glare barrage would blind potential saboteurs attempting to enter industrial properties, yet at the same time provide perfect visibility for policemen to detect intruders.

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## Trouble Shooters

(*Continued from page 48*)

this to say: "The flight engineers' primary mission is to be entirely and intimately familiar with the *whole* ship—not just as to construction and maintenance, but as to engine performance as well. The proper discharge of their duties can very greatly save in time and money at the termination of flights through their direction of the ground crew in locating and correcting whatever trouble occurs In usual procedure, the members of the ground crew would necessarily have to do not only all the repair work, but the previous investigation as to the cause and source of difficulty."

On the time-and-money-saving basis, a good flight engineer can pay for himself many times over in 10 seconds. "I remember one instance," Ray relates, "when just after take-off at La Guardia Field, a flight engineer noticed something was wrong. The oil temperature rose very rapidly and was soon exceeding the operating limits. He was trained not only in how to look for and detect trouble, but in what to do about it. 'The master connecting rod bearing is going out,' he reported to the captain at once, and suggested, 'Feather the No. 2 prop.'

"Ten minutes later the ship was on the runway again. The ground crew found the flaw — the master connecting rod bearing! Another few minutes in the air and all the pistons would have been ruined. An $11,000 engine would have been lost beyond repair."

Ray's grin broadens, proudly. "It doesn't take many things like that to sell anybody, an airline or an Army!"

Safety is the big keynote of airline flying. And here, again, from the commercial angle, the flight engineer takes an invaluable part.

The captain and the co-pilot are watching their instruments, flying the beam, maintaining radio contact with the tower or the station, studying flight plans and airlane charts. But a flight engineer isn't interested in whether he's over Podunk Center or over the Hudson. He's just watching those 200-plus instruments, checking and rechecking continually, letting no slightest variation in correct performance of the ship escape him. He just has to learn to 'feel' when something's wrong somewhere. And that's where the safety factor comes in.

There's another incident that Ray recalls which illustrates this point:

"I was with a check pilot and a student-captain, on a routine check flight—that is, no passengers were aboard. Somehow I just had a feeling something was off-tune about one of the motors, even as we taxied down the runway. The captain ran up the engines to a lively hum before take-off. I said to him, 'That No. 1 engine doesn't sound right to me.' But everything checked okay on the instrument panel. The engines roared again and our ship gathered speed across the field.

"Once we were in the air, the manifold pressure dropped to 28 inches and the power to almost zero in that engine. I guessed it was a break in a piston. We circled the field twice and landed. The ground crew investigated—and actually found a small hole in a piston of the No. 1 engine. Eventually it would have scored the cylinder sides, necessitating an engine replacement."

The flight engineer must know all parts of the ship, and by the time he has had training and experience with Ray, he does! "We all know those Boeings," he laughs, "as if they were people. After two years of doing nothing else, we should! The cabin of old 402 is always hotter in the front than in the rear . . . and 401 hasn't any notice holder inside the cockpit . . . there's only a red border around the fuel pressure gauges to identify it. We know every figure on every instrument on every ship! By the way . . . there's a snag on 401's latch where I keep ripping my thumb . . . I'll have to fix that."

Wherever there are planes, whether on a commercial or on an Army "airline," there must be people who are able to shoot the trouble.

Ray is at present in charge of the future educational set-up for TWA flight engineers. Before the war upset plans temporarily, the company was making preparation to train upwards of 100 young men in this field. Ray had outlined the course and written the study manual. Extension courses, for additional work, had been investigated with both Columbia University and the University of Kansas.

"That is the system as I feel it should be," he explains. "The important thing, I believe, is to find men who are willing to do not only an extra amount of study before taking over their job, but who will be ready to go on studying while they are actually handling the work.

"The picture changes so fast in this business that study is half of the regular work. According to this plan, a man with ability would rate the same chance of advancement as the man with experience. Training would continue, so that a high school graduate could outrank the college graduate. A man could boost himself from the $215 initial pay to the top-flight $325 salary."

Ray's "tools of the trade" are an interesting array. They are carried in a black satchel, like the ones that pilots use. At least 50 tools are neatly filed away . . . everything from a regulation Boy Scout knife to a minute screwdriver. There's a standard flight engineer's manual in the case, with diagrams of heating systems, wiring systems, hydraulic and radio equipment . . . a volt-ohm-meter, to test for shorts in the control boxes . . . and a couple of strange-looking pieces of paraphernalia which Ray explains thus: "I'm lazy. Invented those two things out of some wire and some passenger radio headphone plugs, to save trouble in checking electrical control boxes . . ."

The last item is a slide rule, that typical engineer's emblem. "We're supposed to be *engineers*, aren't we?" comments Ray. "Might as well stick to it, then!"

Most of Ray's hours in the air have been in the flight engineer's seat, but not all of them. He's done a little flying be-


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hind the stick. But a flight engineer's business isn't flying, according to Ray. "It's just seeing that the *ship* flies! With almost 250 instruments to watch, he hasn't a free hand for flying!"

War time flying is giving wings to the flight engineer's place in aviation. And post-war commercial flying is bound to find him with a "permanent berth" as a crew member.

Aviation bigwigs believe that soon after the war, *all* commercial flying will be four-motored.

"Some day, too, the flight engineer's job will be narrowed down," Ray predicts. "He won't have to be a radio man and an electrician, but will have a highly specialized job. He will be limited to 85 hours a month, like pilots, instead of the 120 he now must fly. And he will be trained for his profession in aviation schools, where complete courses will be offered. Two schools, at least, have such work available now."

Flight engineers on America's bombers across the seas are busy today, and essential. "The importance of the field is growing rapidly," says Ray—"and so is the job. It's the *big* new job of aviation —and tomorrow it will be even bigger!"

END

## Convoy Patrol

(*Continued from page* 24)

authority, and at the same time, the responsibility. We don't put an officer in charge of a bomber until we have confidence in his judgment. Then he is pretty much on his own once the plane is in the air."

Nevertheless, there is real teamwork aboard the fighting machines where one man's safety depends on the ability of his shipmates. A pilot must trust the mechanics who service his plane, but they in turn must trust him because they have to go aloft with the ship to earn their extra flight pay.

No enemy fighter planes imperil the patrol bombers, but it's hazardous flying anyway. Convoys don't wait for clear skies, and Banana River flyers strike out to sea in weather which would send peacetime pilots scurrying for shelter. As Ensign Galbraith explains: "Patrol work is the most exact flying there is. It calls for a precise pilot."

Convoy movements are among the Government's most jealously guarded secrets. Banana River officers have no inkling that they must provide a flying escort until just before a column of merchant ships enters the station's patrol area.

Then a bomber crew must get under way quickly, and be able to find the convoy—a relatively small object in the hundreds of square miles of ocean. A plane approaching the merchant vessels is challenged by escorting warships, and must reply with an identifying signal changed every few hours. To give the wrong password is to invite antiaircraft fire.

In daylight an airplane circles the ships, while those aboard keep their eyes open for any suspicious objects in the water. At night the bomber follows a prescribed route overhead, watching for subs in a manner so secret that even the name of the equipment cannot be mentioned.

The Banana River Air Station—now directed by Commander A. W. Gorton—first was conceived as an auxiliary to the huge Jacksonville base. But the excellent landing facilities and the strategic position athwart coastal steamer routes caused the station to be made a separate patrol-training base. Already sizable, the station now is being enlarged.

END

## Help Wanted!

(*Continued from page* 48)

The maintenance supervisor must have not less than four years of full-time paid experience working under the terms of a valid aircraft and aircraft engine mechanic's certificate, two years of which must have been in the maintenance and repair of lightweight training planes such as are used in the CAA pilot training program. Each successfully completed year of resident study, leading to a diploma, in an aircraft and engine mechanic's school approved by the CAA may be substituted year for year for the above general experience, but no substitution may be made for the two years of experience on light training planes. Age limits are 21 to 53.

Ground school supervisors must have held a pilot certificate, have served as a pilot with the U. S. armed forces or have graduated from college and taught CAA ground school two sessions; must hold a valid ground school instructor's certificate with ratings in civil air regulations, aircraft, aircraft engines, instruments, parachutes, navigation, and meteorology; and must have at least two years of full-time paid experience in responsible aeronautical positions. Minimum age is 25.

Flight supervisors must have completed the CAA elementary, secondary, cross-country and instructor courses, while applicants for senior flight supervisor must have a valid commercial pilot certificate and flight instructor rating; 1,000 solo hours of which 300 within the last three years are as instructor; 100 as cross-country instructor; and three months as a CAA flight supervisor or in a supervisory position involving similar duties at an approved flying school.

Also in the employment market is the airport division of the CAA, which seeks civil engineers, preferably those who are pilots or have aeronautical background.

Application blanks for positions with the CAA may be obtained from most postoffices, or from the nearest U. S. Civil Service Commission district office.

END

## Measure Men to Fit Plane

THE WAR DEPARTMENT has announced maximum "specifications" for its fighter-plane pilots. Those wishing to fly the Army's pursuit ships must be not more than 5 ft. 9 in. tall, and not over 170 pounds in weight. Cockpits on these planes are just large enough to hold a man of this size comfortably.

## Flying Collegians

(*Continued from page* 52)

phases of recruiting if they feel they have something in common with the procedure—a group of young men to represent them in the first line of offense.

With college squadrons ringing the bell, a group of World War I Naval pilots in Chicago finally decided to encourage the recruiting of the first all-city squadron. On Sept. 26, 1941, "Chicago's Own" was inducted at a special ceremony at the Glenview air base. More than 3,500 persons attended as 26 men from the Chicago area took their first step toward Navy wings. At present there are eight Chicago squadrons flying for the community as well as the country.

Next of the city squadrons was "Indianapolis' Own" with 37 members. Soon these new units were rivaling the excellence of the college groups. Although Milwaukee had already provided many eligibles for the "Flying Badgers," the city again responded in top-notch fashion to the organization of its "Flying Tornadoes." They set aside a special aviation week to promote recruiting for the city's own squadron. Nine-year-old Jack Draak was made an honorary member of the squadron for contributing the name "Flying Tornadoes."

During the Fourth Annual Winter Carnival at Marquette, Mich., the "Upper Peninsula Wildcats" were born and the induction ceremonies were broadcast over a network of Michigan stations. Sponsored by the Lions Clubs of Dubuque, Davenport and Cedar Rapids, Iowa, the "Flying Kernels" were recruited from western Illinois and eastern Iowa. The recruiting drive was under the chairmanship of George W. Robb and included contests to select squadron name and insignia. Both Mildred Ramer of Cedar Rapids and Harlan E. Addison of Davenport submitted the "Flying Kernels" and were awarded honorary squadron memberships. Winning insignia was submitted by Sister Mary Garbiel, B.V.M., Clarke College, Dubuque. Induction ceremonies were held on Washington's birthday, 1942, at Moline, Ill., and speakers included Gov. George A. Wilson of Iowa, Lieut. Gov. Hugh W. Cross, Illinois, and Lieutenant Commander Olson. There was also a colorful parade of bands, floats and cars preceding the induction of 25 "Flying Kernels" who reported for duty March 12, 1942.

Organized in Du Page County, Illinois, the "White Eagles" are flying the colors of Glen Ellyn, Naperville, Hinsdale, Lombard and Downers Grove. Sponsored by the Elks Clubs of the areas the name "White Eagles" was chosen through a county-wide essay contest won by Phil Hadley of Wheaton. Patsy Flint of Lombard submitted the winning emblem.

Fort Wayne, Ind., "Flying Avengers" were organized by the Junior Chamber of Commerce and included what was then Naval aviation's "baby" cadet, 18-year old William Erdman of Columbia City, champion debater of his school. The name "Flying Avengers" was selected as the result of a newspaper contest.

Nine cities in the Fox Valley and lake

KEEP 'EM FLYING
NEW ENGLAND
AIRCRAFT
SCHOOL
MASSACHUSETTS
BOSTON
A MESSAGE
TO OUR GRADUATES
Your school salutes you for the way you have accepted the challenge to "Keep 'em Flying." From the Army — the Navy — the airlines and the factories in all the United Nations come reports that your N. E. A. S. training makes it possible for you to work at top speed and efficiency. We knew you could do it. You were trained with Yankee thoroughness in our shops and laboratories, and we are expecting even bigger things from you in this mighty war effort. Keep up the good work—your school is proud of you.
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Mass. Reg. 41038
Commonwealth Airport
East Boston, Mass.

shore region of northern Wisconsin participated in the organization of the "Fighting Foxes." Sponsored by the Junior Chamber of Commerce in each city, Dr. E. V. Harrington of Green Bay headed the entire organization. Fifteen-year old Ruth Mary Nowack of Oshkosh won an honorary membership in the squadron by naming the group.

While these all-city squadrons were being organized, college activity was by no means lagging and on October 23, 1941, the second squadron of the "Flying Badgers" was sworn into service. On February 24, 1942, Lieut. Philip S. Dalton administered the oath to 25 members of the third group of "Badgers."

Purdue University formed its second group for induction May 3, 1942. Among the 30 cadets were Co-captains James Miller and Thomas Melton, 1941 varsity football team, Robert Kersey, football and baseball star; and D. C. Adams, basketball player. Induction ceremonies were conducted with the university's 68th annual commencement exercises.

Another squadron from Notre Dame was inducted May 2, 1942, at the Knute Rockne Memorial Stadium between periods of the annual spring football game. On June 11, 1942, the fourth group of "Flying Badgers" reported for flight training and the University of Wisconsin had contributed sufficient flight personnel to make up the full flying complement of an aircraft carrier: four squadrons of 25 men each. Wisconsin's fifth squadron was sponsored by university president Clarence A. Dykstra, and inducted June 1 in conjunction with the graduation program on Madison campus.

The second squadron formed at Northwestern University was dedicated in honor of Donald McCarnes, former NU athlete who was killed January 26, 1942, in the crash of his Army training plane. The group was sponsored by Ade Schumacher, Northwestern director of intramural athletics, and sworn in by Lieut. Henry D. Penfield, former NU football star and mayor of Evanston, Ill., now a member of the Naval aviation cadet selection board in Chicago.

As the Olson idea developed, it automatically created new ideas which furnished additional interest in the Navy's aviation recruiting program. Name contests were sponsored by magazines, newspapers and radio. Similar contests were held for insignia designs which then become the squadron's "fraternity pins." Each member of a college or all-city squadron is presented with a pair of gold wings bearing the name of his unit.

In 1917, Lieutenant Commander Olson enlisted at Great Lakes Naval Station. Later, he attended aviation ground school at Massachusetts Institute of Technology. Entering Pensacola on May 21, 1918, Lieutenant Commander Olson has the distinction of becoming a flight instructor with but 35 hours of flight experience. For a period during World War I, he was engaged in submarine flight patrol duty off the Atlantic coast.

Placed on the inactive list but still retaining his commission, he returned to Lawrence College in 1919, to complete his education. He was recalled to active service and his present post on December 6, 1940. Recently, he was promoted to the rank of lieutenant commander.

END

## Letters

(*Continued from page* 12)

utmost and treasure it among my possessions.

CHARLES E. WADE
Federal Equipment Company
Washington, D. C.

Sirs:

. . . The RAF edition is certainly up to the high standard of the Army Air Forces and Naval Aviation issues, and the three books not only are of the greatest value at the present time, but will be priceless additions to any library of aviation in future years.

FRANK B. HOWE
Public Relations Manager
Curtiss Wright Technical Institute
Glendale, Calif.

END


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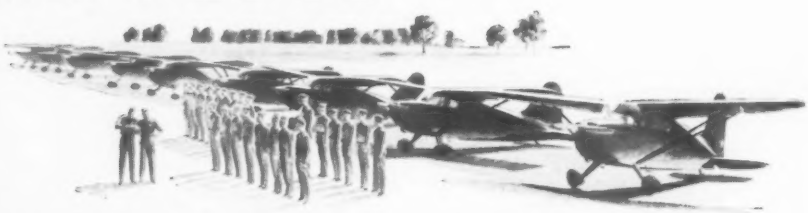
*Ceramic Aircraft*
SPARK PLUGS

C 26 S (shielded)

C 26 (unshielded)



*Champions are prime favorites among Civil Air Patrol pilots because they know they can depend on them in their planes, as in their cars.*

**Characteristic Advantages of Champion Ceramic Insulation Are—**

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## MORE VITAL—MORE DEPENDABLE THAN EVER

Champion Ceramic Aircraft Spark Plugs have revised upward the measure of dependability and long life hitherto expected of spark plugs.

This is directly due to an improved design and a specially developed ceramic insulator that successfully withstands the extreme temperatures and pressures peculiar to high output engines.

The C26 (unshielded) and C26S (shielded) meet the requirements of all but the highest output engines. Special types for these high output engines, embodying the identical insulating material, are making exceptional performance records.

# Industrial Aviation SECTION

## HOW BELL SPEEDS PRODUCTION

by JOSEPH P. BAUER

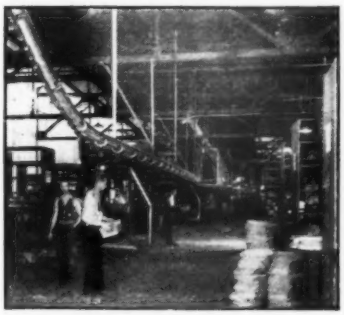
Production Engineering Manager, Bell Aircraft Corp.

THE tremendous acceleration in the production of Army P-39 *Airacobras* by Bell aircraft during the past two years has been achieved in large measure by utilizing every available method of simplifying and speeding fabrication and assembly operations. Some procedures were borrowed from other industries and adapted to the aircraft industry's needs; others were designed to fit the special requirements of the aircraft builder.

At Bell Aircraft, one of the most important steps taken was to limit the type of work to be done at a plant. For example, one plant is responsible for almost all of the fabrication operations in connection with the P-39, and another is concentrating with very few exceptions upon assembly of the fighter plane. This procedure would have been impossible without most careful planning, in advance, and the achievement of complete co-ordination of all manufacturing operations. Complete lofting of all detail parts in the *Airacobra*, too, has played an important part in the overall production plan.

On the final assembly lines drag chains, recessed into the floor, give motion to the wheeled dollies on which the fuselages rest, and pull them forward as assembly operations progress. Overhead monorail systems move engines, cabin superstructures, aft fuselages and propellers to the lines at the proper stations.

In one plant an overhead parts conveyor has been in operation for almost a year carrying an assortment of small parts and sub-assemblies, as well as all types of raw stock. Extending for almost a mile around the plant, it has loading stations at frequent intervals. Markers to indicate destinations are provided on each of the carrier baskets, and a telephone system makes it possible for dispatchers to keep track of each load.



Overhead and ground tracks speed P-39's.

Pneumatic tube systems are now being installed to speed the dispatch of all production control paper work through all the departments of the plants. Several special machines, or adaptations of old ones have been made to speed production, in addition to these steps toward mechanization. Company engineers developed the spar cap milling machine which is in use to do both contour and twist milling on the main structural members of the *Airacobra* wings. This miller is now being manufactured under license, and is in use by the rest of the industry. A leading-edge rolling machine is similarly made available to other manufacturers.

Among other production improvements in use at Bell Aircraft is a special method developed by the company to attach fabric to the control surfaces of the airplane. Utilizing a specially designed hand tool, and a metal retainer strip, it does a neater, swifter job, requiring less handwork. Small tools, tool adaptations and other production ideas numbering in the hundreds are continually submitted by employees, and the best of them are incorporated in the production procedure. The company has a regular procedure for the handling of such suggestions, and the employees are eligible for a cash award or a share of royalties in case the idea is patented. These improvements are made available to the industry through the labor-management committee of the company, which forwards such material to the WPB.

## 100,000 SPECIAL TOOLS BUILT BY BOEING

WITH nearly 100,000 special tools of all kinds and classifications, designed and built since the beginning of the national emergency, Boeing Aircraft Company has demonstrated the "will to win" spirit of the American aircraft industry. Boeing's rapid and extensive tooling program formed the basis for increased production schedules of *Flying Fortresses*.

The work of the tooling department figured substantially in the awarding of the Army-Navy joint "Production E" award to Boeing, the first such award presented to the aircraft industry.

The 100,000 figure does not include standard types of tools purchased, such as electric motors, drilling motors, pneumatic hammers, riveting machines, die sets, nor large presses, dies, machines or countless other tools used in production of the Boeing B-17F. Including these, the total would be almost double.

The largest of the tools made by Boeing are three-story high wing jigs. More impressive than the size of the jigs, however, are the facts that these jigs contain ample working room for large crews of workers on each floor or story, with plenty of light and ventilation for the workers. The jigs can be partially dismantled to remove the completed wing, and reset in a very brief time. Adjustments on the jigs enable the Boeing inspectors to check the accuracy of the jigs to limits of 5/10,000 of an inch, or, roughly about one-tenth the thickness of a human hair.

The smallest of the tools are grommets which are used to hold together the longitudinal and circumferential stiffeners of the *Flying Fortress* fuselage while riveting is started. These grommets resemble the metal eyelets used in shoes to provide a reinforcing for lacing. The *Flying Fortress* grommets are made of aluminum, and are considerably smaller. A handful would run into thousands.

Littelfuse Be. Cu. Fuse Clips on No. 1505 Universal panel for glass enclosed fuse (3 AG, 4 AG, 5 AG) showing 1-pole and 3-pole type.

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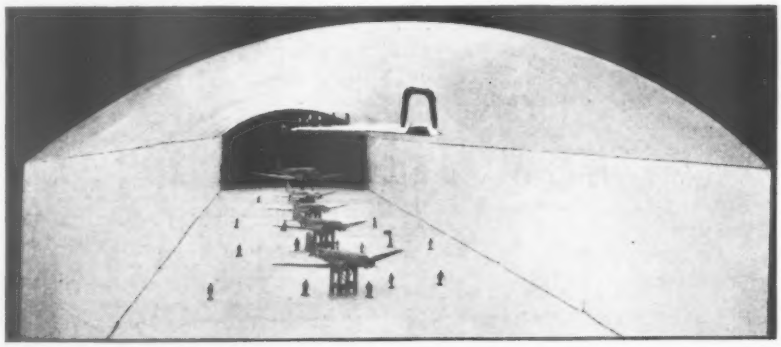
# *INDIRECT LIGHTING FOR AIRCRAFT PLANT*



High intensity, glareless and shadowless illumination will aid aircraft assembly.

LOCALIZED lighting, direct and indirect glare and shadows are eliminated in aircraft factories and other industrial plants by a new method of indirect lighting designed by a Westinghouse lighting division engineer.

Hitherto impractical for industrial use until the recent development of the 3,000-watt mercury vapor lamp, the system was worked out using a working model of an airplane plant. This particular plant will be the nation's first to adopt the new indirect lighting design to obtain high intensity, glareless and shadowless illumination.

A tunnel-shaped plant model shown above represented part of the plant. The high-intensity mercury lighting was simulated by suspending two lines of high voltage fluorescent tubing from the center of the vaulted arch ceiling. Walls, ceiling and floor of the model were made of ¼ inch compo-board and were coated with several kinds of white paint to determine maximum surface reflectivity.

By obtaining reflection factors for the white ceiling and floor of 75 and 65 per cent, respectively, illumination is provided under the wings of model planes placed inside. Although much aircraft assembly work is done on the underside of wings and fuselage, localized lighting to provide the desired illumination is not necessary.

## *AERONCA WINNER*

CO-INCIDENT with the speech of WPB Director Donald Nelson on the value of victory awards in industry, the Aeronca Aircraft Corporation, Middletown, O., has established a system of its own. This method of stimulating initiative and team work among employees has proven more important by all odds than the well known "suggestion box" of more peaceful days, according to executives of this midwest company. Already, some 35 ideas have been accepted by the employees' committee of judges, with attendant rewards, during the few months of operation.

His idea speeds production of L-3's.

The "sweepstakes" winner in the first quarterly allocation of these Aeronca victory awards, Robert Collier, hit the jackpot with an idea which points towards the type of thing which American boys and American ingenuity is doing to win the war. Bob Collier of final assembly offered the prize-winning suggestion for a speedier, more efficient system of installation of airplane brakes as used on the Aeronca L-3 which is now going to the Air Forces in ever-increasing numbers for purposes of training, liaison, artillery-fire control, etc. On the committee's ruling, Bob was reimbursed with the "first and finest" gold medallion, which is given four times a year to the quarterly winner, plus a substantial bonus of war bonds.

## *WORKERS HONORED*

NINE workers in the Packard plant, Detroit, manufacturing Rolls-Royce aircraft engines for Warhawks, Spitfires and Hurricanes, have been awarded the first Certificates of Individual Production Merit and Honorable Mentions, by the War Production Drive Committee.

The awards were granted for outstanding suggestions on ways to speed American war production.

*Part of a task force boards a nine-place glider. Many makes of these new craft are being fabricated with Boots Self-Locking Nuts.*

*They arrive, all set to take over. This is the way glider troops will soon be carrying out assignments on many fronts.*

# Glider Assignment

The entire line of Boots Self-Locking Nuts is carrying out an important assignment with spectacular effectiveness in the rapidly expanding glider industry.

This is particularly true of the Boots "Cage" Nut. Specially devised for use in building planes of plywood and plastics, this recent addition to the Boots family has proved itself indispensable in attaching glider fillets and fairings, in mounting instruments to dashboards, and in many other applications requiring a positive self-locking device. The "Cage" Nut combines the familiar Boots all-metal Wing Style Nut with a special base designed to be clinched permanently into the plywood. Applying it is a *one man* operation, as it can be clinched in from *one side.* Its grip is so firm that it withstands—without tearing the plywood—the torque of bolt or screw insertion when applied by production methods.

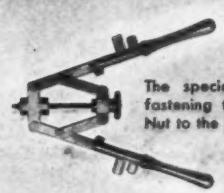
In short, the "Cage" Nut is making possible increased substitution of plywood for vital aluminum on many aircraft applications. Remember, Boots Nuts "Outlast the Plane." Send for new catalogue today.

**General Offices**
**New Canaan, Conn.**

# BOOTS

**AIRCRAFT NUT CORPORATION**

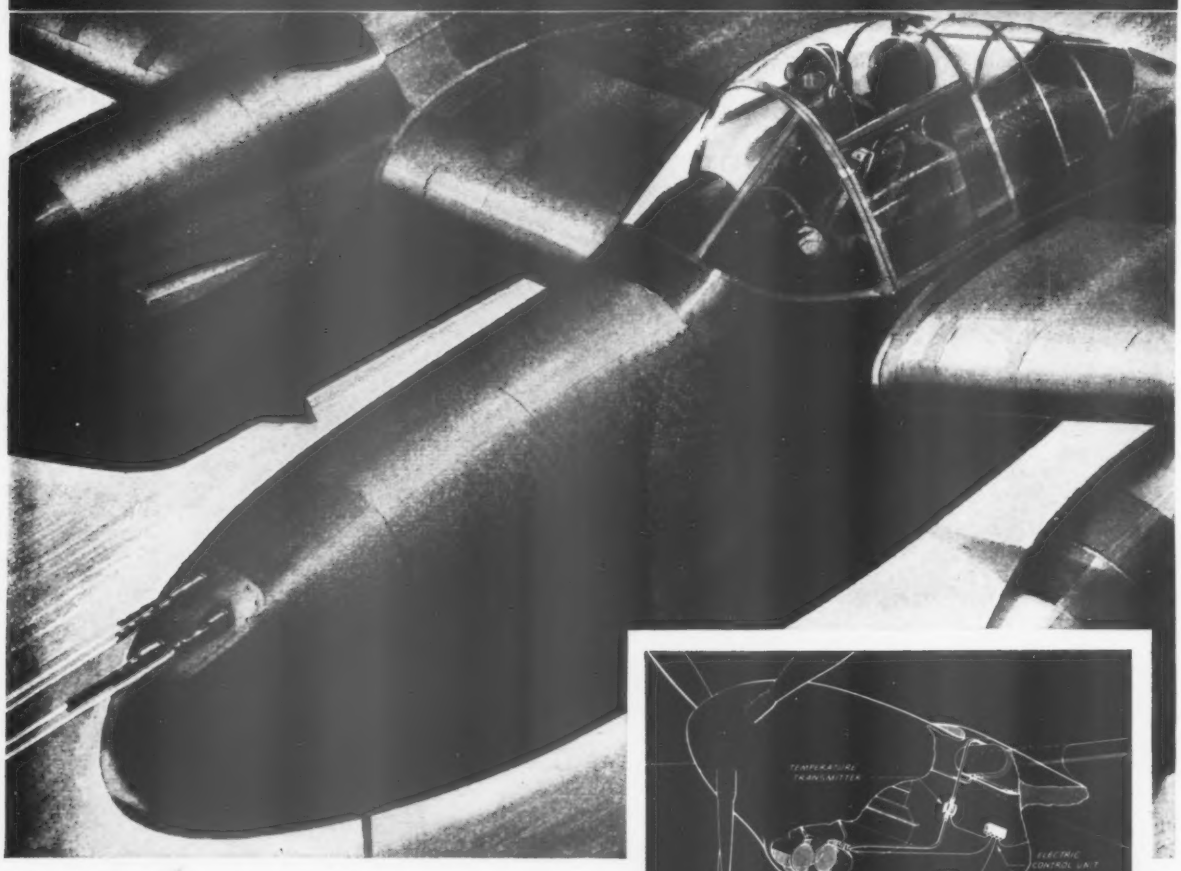
The Boots "Cage" Nut, ready to fasten plywood sub-assemblies for faster production.



The special tool for fastening the "Cage" Nut to the plywood.

When applied, the "Cage" Nut grips the base sheet of plywood permanently. Now it is ready to be bolted to adjacent part of the plane.

*To help him concentrate on gunfire...*

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Adaptable, the system operates on 24 volt D. C. supply and may be used on every type of airplane — with intercoolers, liquid coolant radiators and engine oil coolers.

Successful flight-tests recently completed have proven the reliability and safety of this system. Volume production is now under way. Aircraft manufacturers may write or wire for details.

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## *The Man Behind*— the Man Behind the Gun!

IN TIME OF WAR, the man behind the machine is just as important as the man behind the gun. Back of the production lines of every war industry is their *first line of defense*— the toolroom. Here, where precision is of utmost importance—where tolerances are reckoned in split-thousandths—you will find South Bend Lathes.

Modern in design, built with extreme precision, South Bend Lathes are fast and accurate on the most exacting classes of toolroom work. Their wide range of spindle speeds permits machining with maximum cutting tool efficiency. Their versatility facilitates quick change-over through a minimum of set-up time.

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Bomber part testing has been speeded 400 per cent by use of the comparator.

## MACHINE SPEEDS TESTING OF PARTS

BOMBER part testing has been speeded 400 per cent by Brewster Aeronautical Corporation engineers. This speed-up in testing is possible through a device known as a comparator which operates in connection with a Rockwell hardness gauge. Since every structural part of a bomber must be strength tested, the production time saved through the new device is tremendous.

Russell Gross of the Compressed Air Institute, with whom E. J. Shildkret, engineer and codesigner of the device, discussed this new compressed air application, explains it as follows: "The comparator is used as an accessory to the Rockwell gauge. It comprises a table-mounted yoke which supports a penetrator placed over an anvil. The die end of the penetrator is the same size as that used in the Rockwell gauge. The anvil moves upward against the penetrator under pressure of a piston operated by compressed air under 100 psi. A piece being tested is thus pressed against the spherical die with pressure sufficient to indent its surface."

## FOR SAFETY

SAFETY measures that have increased production and sharply reduced accidents in the Lockheed Aircraft Corporation's plants include two-tone painting of machines, suggested by Tony Salas; and safety illustrations, recommended by Jack Hatton, both of the safety engineering staff.

Machines throughout the plant are being painted a light grey to reduce light loss and make working conditions more cheerful, and moving parts are light buff. In front of each workman, generally on the moving part, photographs of the "right" and "wrong" ways to feed materials into the machine remind operators to avoid dangerous methods.

# PAPER PLASTIC IN PLANES

McDONNELL AIRCRAFT CORPORATION, St. Louis, Mo., has announced that its engineers have used laminated paper plastic instead of aluminum in the fabrication of aircraft shapes. Working in co-operation with a large plastics manufacturer, a paper manufacturing company, and the pulp and paper section of the Forest Products Laboratory, U. S. Department of Agriculture, McDonnell engineers have applied a strong paper impregnated with phenolformaldehyde to fabrication of many of the secondary and some of the primary aircraft structures. These are the structures currently manufactured from strategic materials such as aluminum and steel.

Thus "planes of paper" may be the partial answer to the critical materials shortage which is now facing the aircraft industry. The paper used in the process is made from special wood pulp. There is negligible waste. It is a material which is available in almost unlimited quantities.

In contrast to the large equipment which is used in most plastic work now being done in the industry, it is possible to use relatively light equipment for production with the new process utilizing paper plastic. Molding is done at 250 pounds per square inch pressure, while prior to this development molding has been done at 1,000-2,000 pounds per square inch. Also rather than the customary expensive steel dies, used in current industry plastic work. McDonnell is using the cheaper kirksite dies now used in aluminum fabrication. These represent a comparatively small capital investment in that they may be repeatedly remelted as design changes occur.

## METAL WORKER

LEGIONS of women, young and old alike, are taking over important posts in various departments of Pennsylvania-Central Airlines where it's been "men only" since the birth of air transportation. The ladies are filling posts left vacant by those PCA boys who have gone with the armed forces. Here is Mrs. Marjorie Landa doing intricate work on a carburetor air scoop in the sheet metal shop at the National Airport at Washington, D. C. She is the daughter of the late Congressman Frank Mondell of Wyoming and studied two years at Sweet Briar College before attending a national defense school to take up sheet metal work.

Takes place in airline maintenance work.

## SOLVES PROBLEM

"SIGHTED shortages, solved same." Such was Howard F. Watkins' answer to a rivet problem at Consolidated Aircraft—an answer that brought him $500 in war bonds and cash, highest award yet made under the company's Employee Suggestion System.

Watkins, a leadman at Consair, suggested an idea which has greatly increased the heat treating capacity of rivet furnaces, according to R. M. Davenport, suggestion committee vice chairman.

"There's not a person in this plant who can't do his or her job a little better or a little faster," Watkins declared, urging war industry employees everywhere to take part in speeding production. "Look at what those Commandos do in one raid," he exclaimed. "Compared to them I haven't done a thing. But, with all employees helping, we can do plenty."

Watkins entered Consolidated's employ nearly three years ago upon completion of a metallurgy course at San Diego vocational schools. Born in Ottumwa, Ia., he worked as a motor test inspector and studied electrical engineering before coming west. He now resides in National City with his wife and baby girl.

## PRODUCTION RESULTS

ROBERT E. GROSS, president of Lockheed Aircraft Corporation, recently announced that perfection of mass production methods in both the Lockheed and Vega plants had resulted in an output of nearly as many dollars worth of aircraft and parts in the first six months of 1942, as were delivered in the entire two previous years.

Mr. Gross emphasized the many confusing influences and problems faced today by management in war industries, concluding with: "The facts must be faced. We are at war. Information must be restricted. Unreasonable profits must be recaptured. Production must be increased. Sound financial conditions must be preserved and planning for the future, that does not lessen the war output, must be done."

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## Navy Air Transport

(*Continued from page 54*)

tate, were placed in service at Norfolk, Va., Kansas City, Kas., and Alameda, Calif.

To provide part of the necessary personnel for the new organization, the Navy announced in May the establishment of the new Specialist (V) rating, in which a limited number of men trained in various phases of scheduled air transport work would enlist as Chief Specialists (V), or Specialists First, Second or Third Class, depending on their experience.

Their pay will be the same as that of other petty officers with corresponding ratings. Under present pay scales, the base pay ranges from $60 to $126 a month. Added to this is the allowance for subsistence and rental, which is the same for all petty officer ratings—$2.40 a day, or an average of $73 a month.

Here is the base pay scale for the various ratings: Specialist (V) Third Class, $60 a month; Second Class, $72; First Class, $84; Acting Chief Specialist (V), $99, and Chief Specialist (V), $126. Legislation now being considered proposes increases which would make the scale as follows: Third Class, $78; Second Class, $96; First Class, $114; Acting Chief, $126, and Chief, $138.

For men interested in the new service, the Naval Recruiting Stations are prepared to supply detailed information.

END

## From Headquarters

(*Continued from page 34*)

as our B-17E, but she carries four of the big two-ton "block busters" and a real battery of machine guns. If I had known Clyde Pangborn was flying anywhere near here, I am confident I could have named him as the pilot, for the big ship banked and maneuvered in for the kind of a landing as only that old-timer can perform.

END

## Air-minded Indians

BOYS' and girls' avid interest in flying has brought United Air Lines requests for their aviation kits from such diverse institutions as schools for the blind and for crippled children, orphanages, homes for British refugee youngsters, and Navajo Indian boarding schools. Teachers have received 20,000 of the kits, and the material in them is estimated to have reached 800,000 children.

## 'Intruder Operation'

(*Continued from page 33*)

are nearly gone you are faced with the old Channel again. If you've got something, as I had that night, you sometimes feel uneasy; you feel they've got it in for you and that everyone's going to shoot at you. It's a sort of nervous reaction, I suppose. The whole thing seems too easy to be true. Ten to one there's no Hun within shooting distance and the ground defenses are quiet. That makes it all the worse, and I generally weave about till I'm halfway back across the Channel. If you've done nothing, of course, you don't get this feeling so much because you're still looking for something at which to empty your ammunition—trains inland and barges and ships on the coast. We've had some of these recently, too.

Out over the Channel you can hear your ground station calling the other aircraft of the squadron and you count the minutes and look eagerly for the coast. Often it seems to take so long coming back that you feel sure the compass is wrong and were it not for the North Star I might not be here today.

At last, in the distance, you see the flashing beacon and soon you are taxying in to your dispersal point. I dread the look of disappointment on my mechanic's face if my guns are unfired.

END

## "Pathfinders" Light Targets

THE bomber crews of the Royal Air Force who go in ahead of the rest; the men who light up the targets so that the others can bomb with the greatest effect —these are the pathfinders: a new name among British airmen and one of great honor.

The pathfinders lead the attack, dropping incendiaries so that the *Halifaxes*, *Stirlings* and *Lancasters* that come swarming after them find their targets made clear in the glare of fires.

Sir Arthur Harris, chief of the RAF Bomber Command, gave the pathfinders their name. They are selected for skill and determination out of the whole strength of the Bomber Command and are specially trained and equipped. Each man is a volunteer.

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## Airy Chat

(Continued from page 8)

Many stiff requirements of recent years have been relaxed—and our military and Naval airmen are among the world's best today. Fuzzy-cheeked youngsters are flying four-engined bombers on the toughest missions—and making military history doing it. A few years ago a pilot in command of a four-engined bomber had to have something like 7,000 hours before he could take over command of his ship.

On the opposite side of the ledger, "old" flying generals generally conceded to be ready for retirement continually have amazed the theorists by personally flying their warplanes against the enemy in spectacular and deadly fashion.

In other words, many barriers of previous years are down. If you are itching to fly don't just assume that you can't because of some imagined failing you think you have. Don't be afraid to go through the recruiting mill; hundreds of would-be flyers have been pleasantly surprised.

* * *

JUST an example of what a FLYING article can go through. Look at "Bombs Aboard" on page 56. It looks like a routine, descriptive article that could be assembled rather quickly and without much trouble. But here's the actual case history:

From the Army air base in Kentucky where it was written, the article went to Bolling Field, Washington, D. C., for clearance. A lieutenant colonel typed out a formal letter approving it. From there it went to a brigadier general who also approved it, but who relayed it to the Bureau of Public Relations of the War Department in Washington. There it was approved by two lieutenant colonels who then passed it on to another lieutenant colonel back out at Bolling Field for further endorsement. He checked the article, then sent it over to an adjutant general department captain on the same field who then signed it over to another adjutant general department captain at Mitchel Field, N. Y. From there, after being signed by that captain, the article went back to the Kentucky base.

* * *

Approved, by golly! MAX KARANT.

END

## Air Power and the Second Front

(Continued from page 32)

on the ground. But it was the man on the ground who occupied the land.

Of course, there could be such a condition as total destruction of an enemy nation from the air, after which the pilots and gunners themselves might land, survey the ruins and accept the surrender of the few remaining inhabitants. But who believes that such a fate could befall a powerful nation of 80 millions of people, with not only an army but a strong air force of their own? If the Russians are defeated, or driven back from their oil supplies, with a third or a half of their manufacturing facilities lost, is there any reasonable doubt that the German army, *and air force*, can return to western Europe in great numbers? In that event, will the present British and American air supremacy, or preponderance, rather, then prevail? It may, or it may not. American production undoubtedly will outstrip not only German, but all of conquered Europe's production. But to operate it over Germany, oil and gasoline and bombs and millions of tons of supplies must be ferried over the Atlantic to England." And can they be so ferried in the face of possibly increased submarine interference? In short, can little England with our help endure and knock out the Germans and their war potential in all of Europe? Or will German airmen eventually knock out this small island, now serving chiefly as an aerodrome from which to attack the Germans by air? It is well to remember that we have no patent on air power, though we may produce more of it than our enemies. The worst problem may be to keep it flying.

That is why, it seems to me, a second front now, at whatever the risk, at whatever the cost, is worth trying.

END


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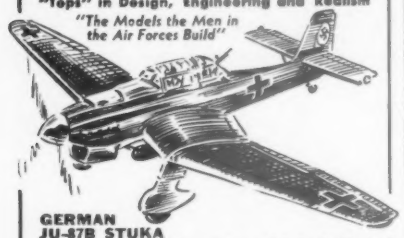

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## Towed Air Transports

(*Continued from page 44*)

ders the job of turning out the glider pilots. The man in this headquarters who does most of the detail work is Capt. Donald Hamilton, who has been flying gliders as well as airplanes for more than 14 years.

Responsibility for the operation of the schools is delegated down through the Southeast, Gulf Coast and west Coast Air Forces Training Centers. These are located at Maxwell Field, Ala., Randolph Field, Tex., and Santa Ana, Calif., respectively.

Requirements for glider pilot candidates are now split into two categories:

1: Those who hold or who have held CAA airman's certificate as private pilot or have made 200 glider flights.

2: Those without previous air training.

In both groups, candidates must be 18-35 years old and pass a Class II physical examination. The latter will pass a man with 20/40 eyesight correctible to 20/20.

Graduates of the Air Forces glider pilot course will receive the rank of staff sergeant with flying status and certification as glider pilot. Many, who meet the necessary educational and leadership qualifications, will be commissioned as 2nd lieutenants.

Candidates in Class A will go to preliminary schools for four weeks of instruction in lightplanes. All landings will be made with the switch cut. Following this they will go to the glider schools for two to four weeks of training in the small and large gliders.

Those in Class B will have five weeks of elementary flight instruction in lightplanes followed by two weeks of dead stick landing practice before entry in the glider schools. The latter will be known as the advanced glider schools.

At these schools, such as the first and still the largest one at Twentynine Palms, Calif., the students will get instruction in two, three, nine and 15 place gliders. The bulk of the transitional training from airplanes to gliders will be done in the three-place gliders converted from lightplanes such as the Aeronca, Taylorcraft and Piper tandem trainers.

The credit for the idea as well as the accomplishment of converting lightplanes into gliders is due Charles I. Stanton, Administrator of the Civil Aeronautics Administration. After the "go-ahead" from the Air Forces it took his engineers only a week to do the design work and conversion of the first Aeronca tandem trainer. Two days later it was towed (with the writer as pilot) 420 miles from Middletown, O., to Washington, D. C. This cross country tow behind a CAA Waco UPF piloted by CPT Supervisor Bill Brown of Columbus, was made under somewhat adverse weather conditions and proved a real test in several ways. The subsequent days of demonstrations to high ranking Air Forces officers at the National Airport definitely decided the advisability of the present production of these ships.

First question one is apt to ask is "Why a *three*-seater?" Answer is that the added seat and cockpit place the pilot or student where his weight takes the place of the engine for balance. The new nose section bolts on in place of the removed (or omitted) engine mount. The extra seat in the rear can be used to advantage by a student waiting his turn. He can learn far more riding along than waiting on the ground.

Other changes in the ship are a glider skid under the nose, a simple lowered landing gear, some additional fin area, a second elevator tab and spoilers. The latter increase the sinking speed of the ship from a normal 400 fpm. to better than 1,000 fpm. and make very accurate approaches and spot landings possible.

Position of the towline release is high on the nose—in line with what used to be the ship's thrust line. This is the best position for airplane towing and this glider will largely be used to teach airplane tow technique.

Two-seater high performance gliders will be used to help pile up motorless hours in the air and to teach co-ordination from a minimum of soaring flight. This type of glider flying, which is what we have known in the past, must be kept to a minimum as the only real resemblance between a sport glider or sailplane and a military or transport glider is that both are heavier-than-air fixed wing aircraft without engines.

The transport glider, with its great size, heavier wing loading, higher flying speeds and greater rate of descent is in effect, as one aeronautical engineer put it, "not a glider, but a transport airplane with remote power plant." For this reason we may soon adopt the new designation of the Navy, now developing these craft for the Marine Corps, which is "trailplane."

How about our big ships? The first of several designs to be tested, accepted and now flying are a nine-place and a 15-place glider. Both were designed and built by the Waco Aircraft Company. They are similar in size as well as design but naturally different in wing loading. Both have untapered wings, the span of the nine-place being 73 feet and that of the 15-place 83 feet. Their construction is conventional welded steel tubing for the fuselage with wood for wings and empennage, the whole being fabric covered.

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END

## Bombs Aboard

(*Continued from page* 58)

safety) in transporting bombs to the airplane.

Tracing the various steps in bomb delivery makes clear the training required. They are loaded onto the bomb trailers by tractor cranes and transported to this storage area. Of course the bombs come blocked up on end entirely free of the fuses or fins. These components are shipped separately, reducing the danger element involved in a freight car's bumping and jostling. For this unloading operation munition workers trained in tractor crane operation are necessary. Skill and co-ordination in handling the many levers are essential.

After the various sized bombs have been transported to the storage area, they must be segregated and placed on the proper dunnage. They also must be inspected for proper lug spacing, proper fuse threading and general condition. This field area where the bombs are stored until needed must be away from the flying field proper, but still within easy driving and transporting distance. Passable roads are essential. Separated dunnage piles, segregated according to sizes of bombs, should be placed perpendicular to these roads in order to facilitate the loading and unloading of trailers. But here again safety requirements creep in, causing bombs to be stored in many small piles, rather than a few large ones. Sand bag revetments are then placed on three sides and the whole area camouflaged if it is to be a semi-permanent location. Naturally, the total number of bombs in the area depends on the number of airplanes and the number of missions contemplated.

Many of the same men who helped bring the bombs to the storage area must be used again in delivering them to the airplane. A steel channel ramp is placed in the rear of the trailer and the bomb urged up this ramp to its proper place by crews using two-man bars. On bombs of 2,000 pounds and up, the bomb service truck's winch and crane must be used.

Arriving at the airplane, the bomb service crew loosens the chains that secure the bombs enroute, places the channel ramp and a cradle in position and slides the first bomb off the rear of the trailer. Two men immediately fin and fuse this bomb, while two others slide the next bomb off the trailer. As soon as the first bomb is properly put together and inspected by the crew chief it is lifted by the hydraulically actuated lift truck and pushed under the plane for loading into the bomb bay. Here again, however, the big 2,000 pound bomb requires special handling. Instead of sliding it down the ramp, a job which in itself would be beyond the physical capabilities of the crew members, the bomb service truck is detached from the trailer and backed to the trailer's side. Here the bomb is lifted from the channel and the winch locked with the bomb suspended in the air. The driver moves the truck forward slowly about 20 feet, while two crew members walk along with the bomb to keep it from swinging or turning. A cradle is placed on the ground under the bomb and the bomb gently lowered onto it. Nose and tail fuse, arming wire and fin then are placed on the bomb while it is in this position.

Before rolling the lift truck under the bomb and cradle, the crew chief inspects the entire assembly to see that the arming wire has been cut to the right length, the proper setting placed on the fuses and the fin set at the right angle for the particular type ship the bomb is to fit. After this inspection all members of the crew co-operate with the lift truck until the bomb is in place under the bomb bay, ready for hoisting by the bomber crew.

From this description of bomb delivery it might be assumed that only men of large, stocky frame are suitable for aviation ordnance company work, but such is not the case. Five small men can, by using the bomb handling equipment properly, do exactly the same work as men of larger stature, in almost the same time.

This new bomb handling equipment's development grew out of the realization that airplanes sitting on the ground partially loaded with bombs are exceptionally vulnerable to attack by enemy bombers. Any hit by an enemy bomb would cause the damage to be multiplied by our own bombs' explosion. Then too, since bombers have to be brought out from hiding to be loaded, the time interval between uncovering and taking off on a mission must be reduced to a bare minimum. For these reasons particular efforts are made to reduce this time interval as much as possible.

With the post-World War I bomb loading equipment—consisting essentially of roller conveyors made either of wood or steel—each bomb presented problems all its own as to exactly how it was to be transported from the storage area to the plane. Further, the bomb was so shaped as not to lend itself to easy handling by large groups of men. Today, after much research in the field of streamline designs, it has been found that the tear-drop shape is not of such great importance, and that cylindrical bombs (which are much easier to construct) can do the job with greater accuracy. Likewise, our new bomb handling equipment for use with these cylindrical shaped bombs has proved itself a simple method for delivering all sizes of bombs to all sizes of bombers.

END


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## Fly Them Over!

(*Continued from page 19*)

It is time for us to realize that the timely delivery by airplane of big military detachments might turn the tide of battle on any front. These big troop-carriers pouring into that sector could expeditiously provide relief to ground troops under conditions of war that seem to change constantly. Our troops are being instructed in parachute jumping, and we must enlarge the scope of our preparation in this respect. Our enemies have used this means of maneuver and attack successfully—in Crete, Libya, Russia, and before the fall of France, Belgium and Holland. One thing is important: we should get under way immediately. We have delayed too long. I propose nothing more spectacular than building and employing airplanes of five times the capacity of anything in the war today.

With 1,000 such aircraft we could transport an army of 8,000,000 soldiers to Europe—or to any other theater of war of like distance in two months; and in another two months, using the larger airplanes, augmented by *Liberators* and like aircraft, now in mass production, we could completely supply such a force.

I am not recommending the abandonment of shipping by sea. It would be logical to continue the construction of ocean transports, and the use of them, as we hope to overcome the submarine menace. But the grave situation today compels us to look for other means of carrying troops and cargoes to aid our Allies. With four-motored aircraft the airlanes are safer. Air transport is much faster and considerably cheaper than convoyed surface transports and by the time the troops are trained and ready, our industry could have the aircraft ready—*if we start now.*

Here is an excellent phase of the subject to consider. Aside from the fact that these big airplanes will be necessary in our efforts to win this war and equally important to us—in our actual possession—to preserve peace when we have won the war, they can be made to pay for themselves in peacetime operation with American crews, under our flag, flying all continents and oceans of the world. These colossal air transports will form the backbone of future world trade. If enemy nations are not permitted to have and operate aircraft under the peace treaty, and we are the only nation possessing such gigantic aircraft, all nations will be glad to get the service and to contribute their share toward our cost of providing and operating such aircraft, if it were necessary. But it will not be.

I foresee the United States as the unilateral and voluntary guarantor of world peace, using these mammoth aircraft daily to spread good will everywhere and enable peoples to meet—faster and oftener—and to know each other better. Mistress of the seas is waning; master of the air is a natural for us. Aircraft has reduced the size of our world, so that those who yearn to conquer will have to look for other worlds. America should

become the hub of a spider-web of airlines with daily service to and from all countries of this hemisphere, and to and from all important countries of the old world. Mighty air carriers can reach any point on the globe in a two-day flight from the United States.

Picture an air trip across the United States in one of these large aircraft. The fare, $50 (⅓ of the present cost of an airplane transcontinental flight); capacity of the airplane on each trip, 400 persons; 75 per cent of the seats occupied with pay-passengers; nonstop flight to New York from Los Angeles, 10 to 12 hours; gross revenue for each one-way trip, $15,000; each airplane making 24 one-way trips a month; monthly gross revenue of each airplane, $360,000; the annual gross would exceed $4,000,000. Our Government could well afford to build and lease these airplanes to our established airlines, domestic and foreign, with an expropriation provision to take them over if and when needed for instant use against an aggressor or a breaker of the peace.

I would say that these big planes, financed in our war effort, offer an excellent source of revenue in peacetime and could be made to pay for themselves and, in a measure, reduce our war costs. It would certainly be an investment—one of few—which would be returned to our people in full measure, even if we disregard its instant availability to force world peace by respect for its ability.

Development of air commerce will prove most lucrative after the war, and we must be ready to have and to hold the cream of world trade immediately the peace treaty is in force. That will require the very aircraft we should now build for wholesale air transport of our armies, together with the smaller aircraft, now being constructed, for countless feeder lines. Our Government should immediately build gigantic troop-carrier air transports, drafting the aircraft industry for the task—with ship builders, good in their own field, helping out, thus keeping them from wasting precious time and priceless material.

END

## Repair Unit

(*Continued from page* 41)

far as trades and professions go.

"These people work 10 hours a day, six days a week. They get Sunday off one week, Saturday the next, taking the two days, or 48 hours, consecutively, once a month. Work is continuous day and night in the foundries and shops where it is most economical for machines to be kept running non-stop. For the majority, however, the work shift is 7:30 a.m. to 6:30 p.m. with an hour's break for lunch and 10 minutes out mid-morning and mid-afternoon. They get a seven-day leave every three months. The average working week is 53 hours.

"Consistently for two years, the sickness ratio has been 0.6 per cent."

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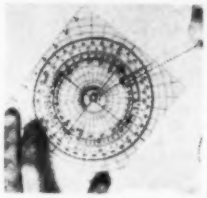

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to the unit for correction of some minor damage, and will wait as long as 24 hours while it is fixed, to a major repair requiring complete disassembly of the aircraft. Bombers and fighters, British and American, can all be handled there. The unit's peak period for production of perfect aircraft out of repair was naturally during the Battle of Britain, when the maximum number of British planes was fighting over Britain and a good quota of crashed German craft contributed quantities of scrap.

One of the repair organization's biggest routine jobs is the thorough overhaul of *Sea Hurricanes*. Each screw and nail of these tough little ocean-going fighters, which travel on a front line ship of every convoy ready to be catapulted into action against enemy bombers at a moment's notice, must be examined for corrosion after each voyage.

Some planes come in for repair with evidence of extraordinary courage and narrow escapes on the part of their crew. A *Hurricane* came in with a deep, straight dent from tip to tip along its wings, as if it had hit a cable square on.

"It must have been going at least 300 m.p.h. to get a scar like that," said the repair unit commander, "and yet the propellers were not touched."

A similar miracle befell a Fighter Command pilot who came in with his spinner badly whammed by a piece that flew off a Jerry's tail as he shot it up. His propellers, too, were unhurt. That spinner now is on exhibition at an aero-engine instructional school. The pilot has since become a squadron leader and awarded the DFC. The spinner will be returned to him as a souvenir after the war.

The chart, as prepared for General Brett, shows how the whole of a repair unit centers around a general equipment store (GES) and foundries and workshops for the manufacture of equipment. Drawing freely on this are shops in which repair of the three main parts of an aircraft is distributed—the airplane repair section (ARS), the engine repair section (ERS), and an auxiliary equipment repair section (AERS). The engine repair section takes care of motors and the retreading of tires, and has several open, rather primitive but thoroughly efficient engine test houses. The auxiliary engine repair section works on damaged turrets, propellers, pumps, cannon, electrical and radio equipment, automatic controls and instruments. The airplane repair section also houses parachute repair.

This whole practical repair organization rests on an administration catering for the domestic, medical, clothing and similar requirements of the repair personnel and the men of the RAF Regiment who, in their army khaki uniforms and air-force blue caps, are responsible for the defense of the station. These men are aided in air raid precautions by the whole personnel of the station. This includes two "lodger units" dependent on the repair unit's administration, one a school of technical training and the other a school of aeronautical engineering. Every man and woman takes a turn at fire-watching or ARP, or both, one or two nights a month.

END


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## Lightplane Goes to War

(*Continued from page* 60)

It was noted that the wording of the order — "commence to manufacture" — would mean that manufacturers would be allowed to complete models which were already partly assembled. Washington sources said that all manufacturers, except one, had already changed or were in the process of limiting their aluminum to the specified quantity before the order was issued.

The further general limitation on the amount of aluminum to be used, after September 1, provides that no plane shall be turned out containing more than 12 per cent of the metal in its airframe "irrespective of whether or not such aircraft has aluminum ribs."

The WPB requires that all manufacturers keep detailed and accurate records of their sales and activities under this order and provides that appeals may be made by any person who feels that the order will work an undue hardship. No reference was made in this order to spare parts, and it was indicated that the arrangement announced at the first of the year—whereby the CAP and other war work groups were granted A-10 preference ratings for this material—would continue in effect.

END

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Who's Who in Aviation, published by the Ziff-Davis Publishing Company, 1942, $5.00.

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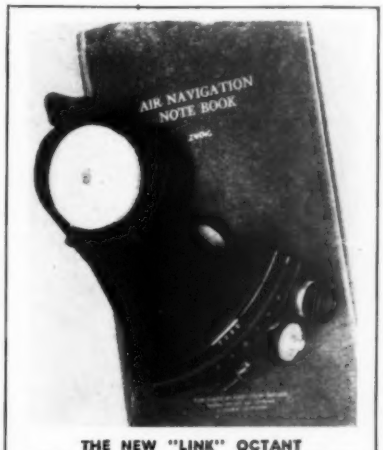


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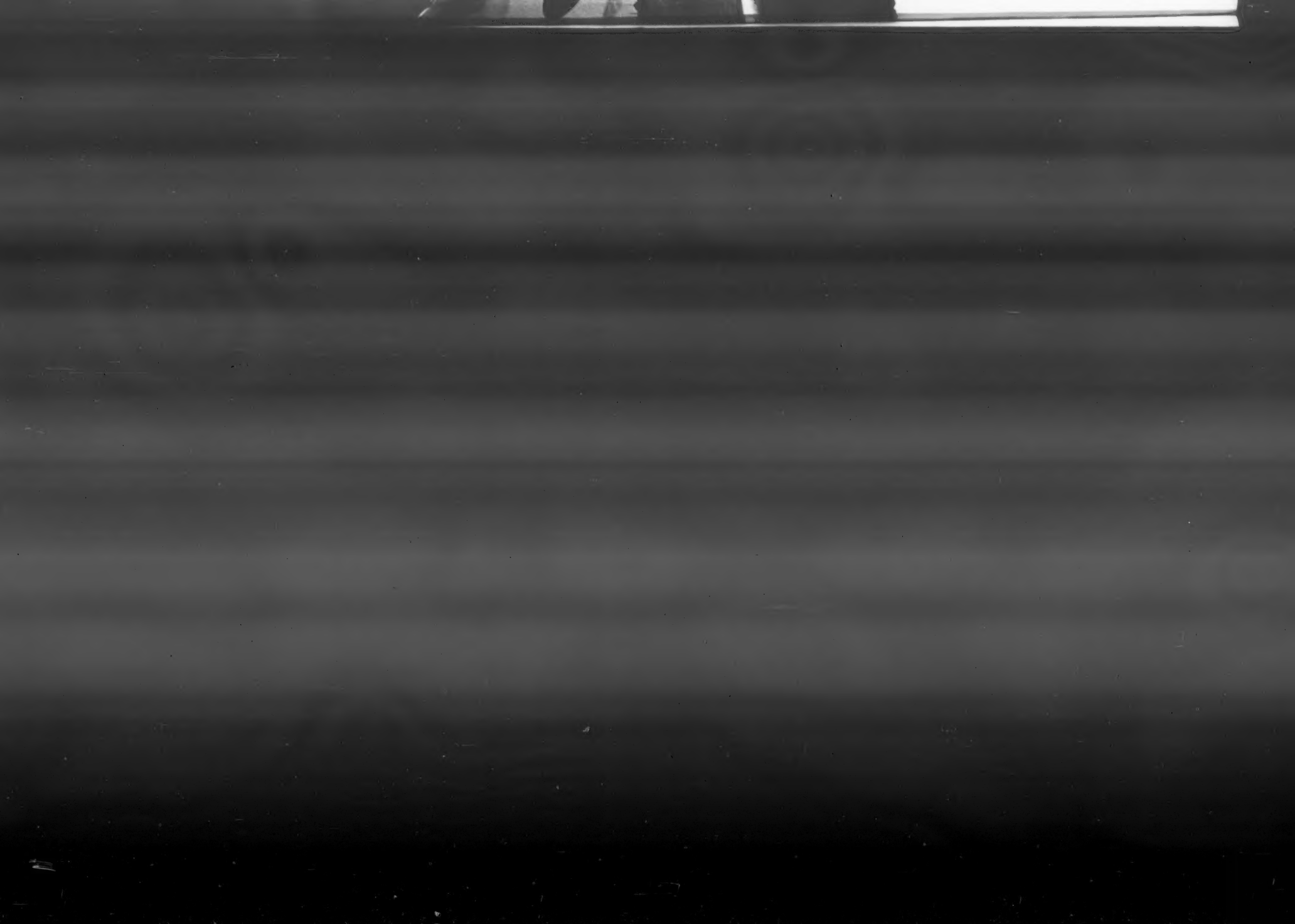

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